APR 4 1921

OFFICIAL JOURNAL OF AMERICAN COLLEGE OF SURGEONS

ANNUAL SUBSCRIPTION: UNITED STATES AND CANADA, $12.00; FOREIGN, $14.00

Volume XXXII APRIL, 1921 Number 4

Surgery, Gynecology and Obstetrics

WITH

International Abstract of Surgery

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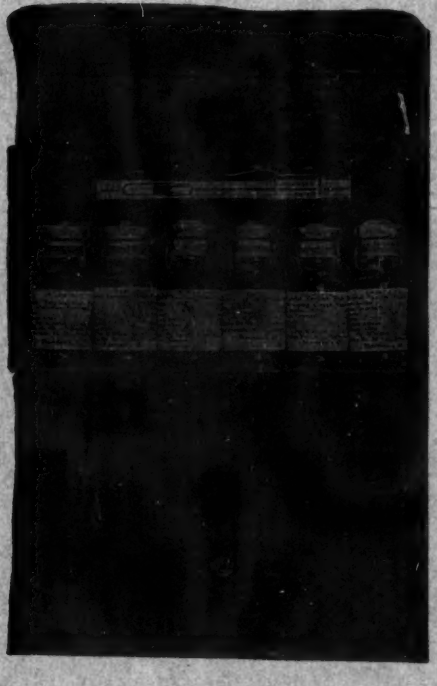

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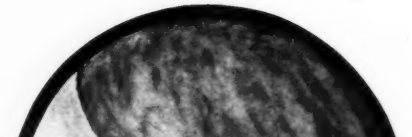

Figs. 1 and 2. Cystoscopic findings in the author's case.

The Treatment of Bilharziasis of the Bladder.—Diomede Petillo.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXXII APRIL, 1921 NUMBER 4

THE TREATMENT OF BILHARZIASIS OF THE BLADDER

REPORT OF A CASE WITH PERMANENT CURE

BY DIOMEDE PETILLO, M.D., NEW YORK
Instructor in the Genito-Urinary Clinic of the New York Post-Graduate Medical School and Hospital, New York

WITHOUT any doubt bilharziasis was hitherto the most tragic and the most disappointing of all the genito-urinary pathological manifestations. This is especially true when one considers the invading tendency of the infection and the frequent dreadful complications which take place in its course. In fact it does not spare any single portion of the genito-urinary tract, so that kidneys, ureters, bladder, urethra, prepuce, glans penis, erectile tissue, prostate, and seminal vescicles, all share more or less in the fell involvement of the bilharzia scourge. Here I transcribe a vivid picture of the last stage of bilharziasis from a recent and complete monograph by F. C. Madden: "The patient is in the last stage of weakness, emaciation, and exhaustion. He often carries his scrotum in his hands and has constant micturition, really an incontinence and dribbling, with pains in the penis and all around the perineum. A very small quantity of urine is voided at a time, which is very offensive, gray-green in color or dark with altered blood, and on standing deposits of phosphate débris, blood corpuscles, pus, and ova are found. A hard mass may be felt in the suprapubic region which is not tender but of stony hardness and extends laterally for some distance. Sometimes an atonic fibrous bladder is found with retention of urine or overflow. One or both kidneys will be found enlarged and tender or in a condition of pyonephrosis; and the much dilated, tortuous, and thickened ureters are easily palpated through the very thin abdominal wall. In other cases, urinary fistulæ may be present, and a hard, distorted, permanent erection is the deciding factor."[1]

An adequate idea of the dreadfulness of the bilharzia is attained from its pandemic character in North Africa, particularly in Egypt. So general is the distribution of the bilharzia there that "in almost all urinary troubles one assumes it is present; and one is only concerned in estimating the degree of infection and its possible influence upon symptoms and prognosis. Moreover, particularly in the country districts, a certain degree of bilharziasis is looked upon as inevitable and, indeed, the early hæmaturia is even considered a sign of manhood, without which the begetting of children is impossible."[2]

Up to June, 1919, the treatment of bilharziasis was simply palliative, and a general skepticism prevailed concerning all the methods which were accumulating without giving any result whatsoever. Among the most popular was neosalvarsan; but after the exhaustive clinical experiments made by Day and

[1] F. C. Madden. The incidence of bilharziasis in Egypt, etc.
[2] Loc. cit. Urol. Rev., 1918, Dec.

Richard it was discarded. Binet and Clayton-Green employed intravenous injections of perchloride of mercury with only some benefit, the authors being unable to report a single case of recovery. Regusis experimented with a serum derived from bilharzia patients, "bilharzia red serum," while Day worked with microcidine by intravenous injections, but no conclusive data have been drawn from these experiments.[1] Madden used extract of male fern but as to a relatively valuable trial treatment nothing is mentioned in his beautiful monograph. Walker in his textbook merely emphasizes that "no method of destroying the Schistosomum is known."[2] This sums up the most important literature concerning the treatment of bilharziasis until June, 1919, when fortunately Christoferson's method was announced. I believe his method must be considered a veritable specific means of curing bilharziasis rapidly and permanently. The history and course of my case follows:

Date, June 4, 1919.

S. S., age 27 years; male; married; laborer; referred by Dr. A. Scaturro, of New York. Family history negative. Three years ago patient was affected with multiple venereal ulcers associated with suppurated inguinal adenitis. Almost contemporaneously he began to suffer from an obstinate hæmaturia which lasted 4 months without interruption, subsiding for a few days, only to reappear again and again at brief intervals. The character of this hæmaturia was always terminal and dribbling. There never were any objective urinary symptoms of importance with the exception of a slight burning sensation in the posterior urethra. Two years after the first appearance of hæmaturia the patient was married, the urinary symptoms having no weight on his determination. Early in the second month of his married life he began to notice a certain impairment of his sexual power that gradually became more apparent until he was compelled to consult his physician for weak erections and very precocious ejaculations.

With these symptoms he came under my observation. The physical examination revealed an apparently healthy young man with no evidence of any anatomical or functional deviations. A Wassermann reaction was made which later on proved to be negative. External genitalia normal. Prostate and seminal vesicles were normal in size but rather indurated and tender to the slightest touch. The prostatovesicular sinus had disappeared. There was no liquid at the meatus after a gentle massage Ordinary stream small and slow. Urine macroscopically clear in the first two glasses, containing, however, a few typical prostatic shreds. The third glass became cloudy at the end of the micturition owing to 4 or 5 drops of blood.

Cysto-urethroscopy. Vesical capacity normal. The sensitiveness of the bladder was only slightly increased. The bladder appeared uniformly and exaggeratedly congested. Here and there groups of tortuous vasa projected clearly on the surface of the mucosa. The main cystoscopic finding consisted in two growths of the massive and sessile type; a larger one, in shape and in size resembling an ordinary strawberry, and a smaller one of the size of a lentil situated a few millimeters below the first one. They were implanted on the right lateral wall just above the corresponding ureteral meatus in a very vascularized territory and offered the eye a peculiar view never encountered in the common neoplastic and inflammatory conditions of the bladder. Disseminated over the entire rough surface of the little tumors one could see many yellowish miliary granules descending around the base and gradually disappearing on the adjacent mucosa. In withdrawing the instrument a small group of ovoidal bodies was visible. These were seen projecting from the right lateral portion of the edge of the sphincter which appeared deeply œdematous (frontispiece). In the remaining sections of the bladder, numerous yellowish granulations were scattered all around. The prostatic urethra showed all the pathological changes of a long-standing intense, inflammatory process. The thick, injected, greyish mucosa was extremely fragile and liable to bleed very easily. The verumontanum was transformed into a shapeless mass whose characteristic structures (utriculus and ejaculatory ducts) were lost among the prominent flabby granulations. The lateral sulci had lost their usual appearance inasmuch as the physiological sinus structure had been substituted by only a slight lowering of the everywhere overabundant and projecting mucosa. Asked whether he had ever been living in a tropical country, the patient said that during the last Italian military expedition in Africa (1913) he was in Cirenaica and Tripolitania for about 18 months, as a soldier. This circumstance put an end to my hesitations and an abrupt probable diagnosis of bilharziasis was made.

A piece of tissue, taken by means of a forceps from the tumor, and a sterile specimen of urine were sent to the pathological laboratory of the Post Graduate Hospital and a few days later a report signed by Dr. MacNeal, plainly confirming the diagnosis. The tumor proved to be papillomatous in character and among the cellular nests were found many ova. A morphological examination of blood gave: polymorphonuclears, 53 per cent; lymphocytes, 17 per cent; large mononuclears, 24 per cent; eosinophiles, 6 per cent. As one can see the eosinophiles were not so markedly increased as they generally are in the trematode group infections.

[1] Loc. cit.

[2] Walker. Genito-Urinary Surgery. New York: Funk & Co., 1914, 451.

The patient was put on an appropriate diet and urinary antiseptics. A few days later I resorted to the fulguration of the little tumors and of the three bigger nodules on the vesical edge of the sphincter, the latter representing accumulations of calcified ova.

As to treatment the literature up to date is very meager and discouraging and from it I was convinced that it would be useless to try the already mentioned methods. I therefore decided to try some new means of treating the patient, for even with the prospect of being ultimately discarded, it would still be worth while, provided it did not harm the patient. I used hypodermatic injections of carbolic acid and in order to watch the urine and to study the limits of renal endurance I advised the patient to enter the hospital. I started treatment with a subcutaneous dose of 8 centigrams of carbolic acid injected twice a day in the gluteous region. This daily dose of 16 centigrams was administered continuously for 10 consecutive days after which I added 8 centigrams more, reaching a dose of 24 centigrams which was administered for another week. During this period urinalysis and microscopic examinations of the sediment were made several times by the Bendiner & Schlesinger Laboratory, of New York, and the reports have always been positive for bilharzia eggs. I gave the patient a week's rest after which I started a second series of injections giving now a full dose of 24 centigrams of carbolic acid a day from the beginning. During this second period four urinalyses were made all with positive report the only encouraging point being a relative paucity of eggs. A second intermission of 10 days was suggested during which two out of the three urinalyses made gave a negative report. But the illusion was of short duration because later on the eggs began to reappear in the sediment.

It was just in this period of uncertainty that I happened to read the communication by Dr. J. B. Christoferson of the Civil Hospital of Khartoum, published in the June 14, 1919, issue of the London *Lancet*. The author who has been working in a zone particularly affected by the bilharzia claims that antimony tartrate has been used by him with permanent curative result. He employed a fresh solution of the medicament in proportion of ½ grain per 3 to 4 cubic centimeters of physiological salt solution. The injection, made intravenously, is repeated for several consecutive days and every other day afterward. For each injection he increases the original dose by ½ grain until a maximum of 2 or 2½ grains is reached. The total dose for a complete cure oscillated from 20 to 30 grains. The purpose, he says, is twofold: first, to kill the parent worms in the portal venous system; second, to sterilize *in situ* the ova deposited on the different organs. The author affirms that the ova resist the action of antimony longer than the worms, so that when we succeed in sterilizing the ova it means that the worms have been killed. I quote his own words: "We have found, after about 12 grains have been injected in about as many days, that *some* of the ova are shrunken, shrivelled, blackish, and the contents granular, and appear as if they had been oxided, and that these would not hatch out in water however long they were left. As injections proceed, an increasing proportion of ova eliminated are granular and dead. Now when it has been confirmed for 2 or 3 days none of the ova hatch out, then the time has come to suspend the injections, for both objects have been accomplished. From observation in our case I think that this takes place after about 20 grains have been injected, but it may be less and it probably varies in different cases."

The patient having refused to enter the hospital I had to consider the case as an ambulatory one. Realizing the possibility that the administration of antimony might endanger the functional capacity of the liver in a man who was compelled to go around in his daily work, I had to be prudent; so I decided to modify the Christoferson method by injecting only a constant dose of ½ grain of the medicament diluted in 10 cubic centimeters of fresh physiological salt solution. In addition I prescribed a small dose of saline solution (sodium phosphate) to be taken every night at retiring and recommended the patient a purin-free diet.

I began the treatment on October 2, 1919, but owing to the fact that the patient had to leave New York for a week, it was interrupted on the 11th, at which date a cumulative dose of 4½ grains of the medicine had already been injected. At this date examination of centrifugated sediment of urine still showed living ova of bilharzia. October 20 a second series of injections was inaugurated and continued without any interruption until December 30, thus reaching a total dose of 40 grains. I want to note that during the intravenous treatment of antimony, occasional irrigations of the bladder were practiced either with 1:3,000 solution of silver nitrate or with 2 per cent mercurochrome.

Table I gives the record day by day, as the laboratory of Bendiner & Schlesinger sent in the reports:

From the date of the last injection (December 30, 1919) to February 27, a number of urinalyses, made every 3 or 4 days, gave an invariable negative report

TABLE I

Date		Dose of Antimony Tartrate Injected (in grains)	Bilharzia Ova
October	20	4½	+
	22	5½	+
	24	6½	+
	26	7½	+
	29	9	+
November	2	11	+
	5	12½	+
	8	14	+
	12	16	+
	15	17½	+
	19	19½	+
	23	21½	+
	27	23½	+
	*29	24½	+
December	2	26	+
	6	28	+
	10	30	+ very sparse; shrunken, dead?
	15	32½	idem
	20	35	idem
	24	37	idem
	27	38½	idem
	**30	40	idem

* From this date on, the urine had been voided after a previous massage of prostate and seminal vesicles.

** Treatment stopped.

for bilharzia ova. The last one, made in the pathological laboratory of the Post Graduate Hospital, signed by Dr. W. J. MacNeal and dated July 31, 1920, gives a negative report as to bilharzia ova.

A cysto-urethroscopic examination performed on June 23, 1920, showed an almost normal bladder with the exception of a few abnormally vascularized small and limited areas of the mucosa and a rather notable degree of hyperinjection of the trigone plus anœdematous condition of the region of the internal sphincter. The posterior urethra, although a great deal ameliorated in its general appearance, still showed a remarkable degree of œdema and congestion, the verumontanum being very prominent and granulating. The lateral sulci and prostatic fossetta appeared far from being cleared of that thick imbibed mucosa characteristic of all exudative inflammations of long standing. The hæmaturia had disappeared since the beginning of the treatment and the urinary streamwas very much improved. The despondency of the patient was greatly lessened but the sexual disorder for which he was referred to me was still unchanged. Naturally if we remember that the impairments of the sexual sphere may be directly depending on anatomical lesions of the prostatic urethra and particularly of the verumontanum, when they exist, it is obvious that they require special attention from the urologist.

A noteworthy circumstance in this case is the fact the patient's wife remains entirely immune from bilharzia as far as I could ascertain through a careful examination of the genito-urinary tract and urinalysis. This would corroborate the assumption made recently that for the transmission of the infection from one to another subject a third medium is necessary.

HABITUAL OR RECURRENT DISLOCATION OF THE SHOULDER

Forty-Four Shoulders Operated on in Forty-Two Patients

By T. TURNER THOMAS, M.D., F.A.C.S., Philadelphia

THIS condition is common enough and its results sufficiently disabling and difficult of cure to give any promising treatment a hearing by the profession. Many devices have been contrived to prevent the recurrences but operation, thus far, has produced the best results. These results, however, have varied much and the best operation has not yet been decided. A very interesting paper by Ollerenshaw, of London, and an unusually good discussion appeared in the *Journal of Orthopedic Surgery* for May, 1920. The purpose of the paper was to support the Clairmont operation in which a flap of the deltoid muscle is passed from behind forward under the neck of the humerus and its end sutured to the same muscle in front so that it afterward acts as a sling to hold the head in the joint. He operated on three cases in the preceding year by this method and to the time of publication there had been no recurrence in any of them. In a preceding case he did a capsule operation (excision of a portion of the capsule) and he says of that case that the operation "has been followed by a perfectly stable joint, although it is now nearly a year since it was performed and the man has worked as a collier since April, 1919."

In the discussion which followed the reading of the paper, Major Dunn, Birmingham, said that he had seen a good many operations for this condition and that in his experience "excision of a portion of the capsule or plication of it has not infrequently been followed by recurrence." In one case in which this operation had failed, Clairmont's operation gave a good result. He did the latter operation on a case 15 months before with complete return of motion in the joint. The patient was a farm laborer and promised to report any further trouble. He had not been heard from since the operation. Mr. Bristow, London, had an epileptic patient who had dislocated his right shoulder 18 times and his left 16 times and on whom he had done the Clairmont operation on the right shoulder 6 months before. Although the patient had had several fits and had dislocated his left shoulder four times, the right had not since gone out. He had since operated on the left shoulder as well. Bristow thinks the good results are due to the strengthening of the capsule by the "lump of ragged muscle," and further strengthening by the addition of fibrous tissue, not to the specific action of the transplanted flap of muscle. Platt did this operation 5 years before, and there had been no recurrence of the dislocation since, but the patient was a professional acrobat and had been unable to return to the stage. He had lost so much deltoid that his shoulder-joint musculature was incapable of bearing the brunt of the gymnastic maneuvers. Trethowan had plicated the capsule in two cases, in one 12 months before and in the other 15 months before. He had not heard that they had recurred since. He found a general distention of the joint and had difficulty in plicating the capsule so that he doubted if plication in the above cases had been done well enough.

In March, 1909, in the *American Journal of the Medical Sciences*, after a thorough study of dislocations of the shoulder, based upon cadaver work done previously in conjunction with the late G. G. Davis, I presented my reasons for attacking the recurrent dislocations by operation on the capsule through the axilla. Since then three papers have been offered in support of this operation and now a four years' accumulation of operative experience is presented for the same purpose. Henderson, in 1918, reported seven cases on which he did a capsule operation and one on which he did a Young operation. In one case the operation had been done too recently to permit a report on it. One case was a failure after both a capsule and the Young operation (lengthening of the tendons of the pectoralis major and latissimus dorsi).

In one case the recurrences were reduced from 12 or more in a year to 2 in the year and a half preceding the time of reporting it. The remaining five may be called cured. The purpose of my paper is to show that the axillary capsule operation is the most rational and most successful, but that it is also anatomically almost impossible.

Extremes of movement at the shoulder tend to force the humeral head out of its socket but are checked by the tightening of the capsule on the opposite side of the joint. The freest and most dangerous movement is abduction, next to that comes external rotation. When the abducting force is too great for the resistance of the capsule the latter tears and the head escapes from the socket into the axilla forcing the torn capsule margins apart. With each repetition of the dislocation these torn capsule margins are separated and finally they cicatrize together across the gap in this distended or separated condition. We thus have added to the normal length of the axillary portion of the capsule a new or cicatricial piece so that when the arm goes into extreme abduction afterward, the capsule can no longer tighten up and prevent the escape of the head from the socket. There is now no necessity for a tearing of the capsule to permit the head to leave the socket and soon after the reduction of the recurrent dislocation the patient is free of pain because there is no inflammatory reaction. The purpose of the capsule operation is to contract this portion of the capsule to within the normal length and afterward lengthen it to the normal by suitable exercises. I now never concern myself about too much stiffness after operation but am concerned if there is too little. This contraction is usually accomplished by excising a portion of the capsule and sewing or allowing the edges to cicatrize together, or by incising the capsule and overlapping the margins by sutures. In other words, the purpose is to reproduce very closely the conditions existing immediately after the reduction of the original dislocation. With the arm in adduction and internal rotation, as in the Velpeau position, the torn axillary portion of capsule would be relaxed and wrinkled so that when cicatrization developed it would be abnormally contracted and the opposing movements, abduction and external rotation, correspondingly limited. We would then have the usual stiff and painful shoulder which we see is the normal healing result of the essential lesion of a dislocation of the shoulder, a torn capsule. The dislocations recurred because the arm was not kept at the side long enough to permit the proper cicatricial contraction of the torn capsule. This is particularly liable to occur in two classes of people, athletes and epileptics, the former because they will not keep the arm at the side long enough for firm healing, and the latter because they have so little control over the situation. If after an operation when the bandages are removed, usually in 3 or 4 weeks, the arm can be placed in nearly full abduction and external rotation, I would be much concerned about the development of recurrences. I have seen delicate women get rid of severe stiffness almost entirely in a year or two without special attention or effort. A strong man can get rid of the worst degrees of cicatricial stiffness following these operations in a short time.

The real problem in these capsule operations is to expose the affected portion of the capsule which lies directly over the dislocated head. Now the head dislocates into the exilla in the overwhelming majority of cases so that the axillary or antero-inferior portion of the capsule should be contracted in them. In one case of recurrent posterior dislocation I exposed and contracted the posterior portion of the capsule, *i.e.* the portion directly over the prominence of the dislocated head and no recurrence of the dislocation ensued. In another similar case the same operation failed but there were special difficulties associated which I hope to take up in a future paper. In all of my other cases in which the dislocations were anterior, except in an atypical one, I contracted the capsule through an axillary incision. The posterior operation was very easy but the axillary operation is not easy and calls for an intimate knowledge of the anatomy of this region. The axillary operation is now done posterior to the axillary vessels and nerves, while at first it was done anterior to them. From my experience with operations

on the living and experimental work on the cadaver, I am convinced that few of these cases are being operated on because of the anatomical difficulties by whatever route selected.

Let us specify, for example, a few of the difficulties. In the usual anterior dislocation the escaping head tears the capsule underneath the large axillary vessels and nerves and comes close the surface below them, *i.e.* posterior to them. This part of the capsule is normally covered completely by the subscapularis muscle. Immediately in front of this muscle and directly over the capsule we find externally the coracobrachialis and short head of the biceps and internal to them the large axillary vessels and nerves. Now the whole area of capsule involved and possible of exposure, if none of these structures obstructed, is only about 2 inches square. There are three possible routes by which it could be exposed in part and in every one of them the exposure is very limited; the deltopectoral or that external to the short head of the biceps; the anterior axillary or that between the coracobrachialis and the axillary vessels; and the posterior axillary or that posterior to the axillary vessels.

My objection to the deltopectoral exposure is that it is too far out. The humerus must be in extreme external rotation to get any exposure of the capsule and even then it will be very limited and will not be at the site of the original laceration. I employed this route for the excision of the humeral head through the anatomical neck in two shoulders and again for a capsule operation in an atypical anterior dislocation. The exposure was very difficult and limited until in the last of the three I divided the tendons of the coracobrachialis and short head of the biceps at their origins from the coracoid process and even then it was still very limited. The subscapularis tendon must be divided. I once had the opportunity of watching a prominent surgeon expose the capsule by this route and became convinced that to him the exposure was difficult and limited. I have had two cases in which this incision had been employed, in one case by a surgeon whom I knew to be a good one and in the other by a surgeon whom I believed to be a good one. It is a fair inference that a satisfactory exposure was not obtained in either case because the dislocations recurred afterward as if no operation had been done. Later I did the axillary operation on both cases and there have been no recurrences since these operations, that in one case done 11½ years ago and in the other more than 4 years ago, the second patient being an epileptic.

The anterior axillary operation which I did in my first ten cases made the exposure between the coracobrachialis and axillary vessels and divided the subscapularis partly. The approach to the joint had to be made carefully and with due respect for the anatomy, but the exposure was freer than by the deltopectoral route and directly over the site of the capsule lesion. I continued to use this route until I realized that during the dislocations the humeral head came close to the surface behind the axillary vessels when I decided to make the incision in this situation. All of my operations on the usual anterior dislocations since then have been by this posterior route. I am not now especially recommending it but am particularly trying to show why this condition is operated on infrequently—because the affected portion of the capsule is almost inaccessible by any route. The posterior axillary route gives me the freest capsule exposure just where the variations in the joint lesion are best detected, divides no muscles, usually requires no ligatures for divided vessels, and gives perfectly dependent drainage which is necessary during the first 24 or 48 hours for an uncontrollable oozing which practically always occurs. The circumflex nerve, however, must be guarded carefully as it lies directly in the field of exposure. I once cut it but had every opportunity for careful and accurate suturing of it. The patient was not told of the accident. After the usual stiffness and weakness following the operation had time to disappear, the patient never complained of any signs of paralysis although he was a hard working man and did much heavy lifting. This accident was directly the result of changing my technique in my efforts to simplify the operation. The young surgeon can not afford to

forget that the operation is distinctly an anatomical one, and he should make his own selection as to the method by which he will approach the capsule according to his confidence in his knowledge of the anatomy of this region. I have never regretted doing the operation and am quick to recommend it to a patient suffering from this condition. It usually takes about a half hour for its performance according to the condition of the joint found. I have no fear of infection. The patient usually gets out of bed 2 days after operation and frequently in one. He practically always leaves the hospital within a week with his arm in bandages as after the reduction of the first dislocation and he is in about the same condition. Good surgical technique and a thorough knowledge of anatomy make it one of the safest and most effective operations in surgery.

The effectiveness of the operation depends, of course, upon the completeness with which the cause of the recurrences is removed, and this will depend largely upon the degree to which the causal condition can be exposed. In the original luxation, the capsule tears along the glenoid margin or its humeral attachment, or somewhere between and more or less parallel to them, and is the result of hyperabduction. The new cicatricial addition to the capsule already described may be of the normal thickness, it may be thicker than normal or it may be of only synovial membrane thinness. It will not always be possible to detect such thin areas with the limited operative exposure so that a very thin and weak portion may be left and a portion of substantial thickness be excised instead. This may account for some recurrences after operation. In one case the hyperabducting force instead of tearing the capsule from the glenoid margin tore away the anterior half of the glenoid process and in the recurring dislocations the humeral head pushed its way between the two glenoid fragments. No operation on the capsule would suffice in this case. The fractured surfaces of the fragments were thoroughly curetted and afterward held apposed in their normal relations to allow firm bony or fibrous union. There were no more recurrences of the dislocations. In another case the anterior half of the glenoid cup had been worn away by the repeated recurrences so that not enough cup was left to hold the head properly. The capsule operation as was expected, proved insufficient and a second operation was done in which the posterior half of the socket was chiselled away until the anterior half was slightly raised. No recurrences followed this operation which was done more than 11 years ago, although the patient was an epileptic. Not infrequently as in this and the preceding case the condition found at operation will call for some special deviation from the ordinary procedure so that the best possible exposure of the capsule and joint is desirable.

In my opinion we shall never understand the pathology of this and other common traumatic conditions of the shoulder region until we appreciate the part played by the fall on the hand and its hyperabducting influence at the shoulder. A dislocation is a fracture of the skeleton at a joint with displacement of the fragments on each other by the fracturing force and a recurrent dislocation is merely an ununited fracture, *i.e.*, a fracture with abnormal movements of the fragments on each other in the direction of the original fracturing force. The ligaments at a joint are to the skeleton what the bone is between the joints. In a recurrent dislocation of the shoulder the axillary portion of the capsule torn by the protruding fragment, the humeral head, in the first dislocation, never had a chance for close firm union afterward because the lower fragment, the humerus, continued to protrude in the direction of the original fracturing force on slight provocation. The fracturing force in the common anterior dislocation is hyperabduction, external rotation also perhaps playing a part; therefore any slight force in these directions, as putting the arm into the sleeve of a coat, easily causes a recurrence of the dislocation. According to its frequency and violence, the anterior margin of the glenoid cup and posterior surface of the humeral head where they come into violent contact in each dislocation, one or other or both, wear away and lessen the resistance of the joint to dislocation. Exact plastic work on the affected portion of the capsule is rendered difficult by the obstacles to its free exposure.

Sometimes the tearing capsule pulls away a piece of the anterior margin decreasing the retaining capacity of the cup. Sometimes the anterior surface of the glenoid process and adjacent surface of the scapula are denuded of periosteum and there is a considerable pouch or pocket between the bone and overlying subscapularis muscle freely communicating with the joint. The task here is to reattach the capsule to the bare bony margin of the glenoid cavity from which it was originally torn. In such a case Perthes nailed the capsule to this bony margin after an extensive incision. Hildebrand packed the wound with gauze to favor adhesions and cicatricial tissue formation, a procedure I have followed in such cases.

RESULTS OF OPERATIONS

In SURGERY, GYNECOLOGY AND OBSTETRICS for January, 1914, I reported in considerable detail the results of operation on 18 shoulders in 16 patients. I now have 26 more cases to offer which will require too much space for such a method of presentation. What we need perhaps more than anything else is to study our failures.

Of the 44 shoulders operated on, in 2 the dislocations were posterior and in 42 anterior. In the first posterior dislocation operated on the capsule operation has been successful more than a year afterward, in the second the same operation proved a failure with the first convulsion following operation, both cases being in epileptics. In the failure the joint condition found at operation proved difficult to combat, especially with so little time to deliberate, and I could not then think of a satisfactory solution to the difficulty. The posterior recurrent dislocations are so infrequent, my experience is so recent, and the problem presented so new, that the subject should receive separate consideration.

ANTERIOR DISLOCATIONS

Of the 42 anterior dislocations operated on 24 occurred in nonepileptics and 18 in epileptics.

Nonepileptics. In 18 of the 24 there has been no dislocation since operation, the three most recent cases being operated on three months or more ago and the first nearly thirteen years ago. Two of them died, one 16 months after operation and the other 6 years after operation. Several have been vigorous athletes after operation; others have been coal miner, laborer, farmer, river bargeman, prize fighter, etc.

It may be of interest to note again to what degree I have gone in my efforts to determine the strength of shoulders operated on. In all of the nonepileptic cases only the capsule operation was done, in three shoulders in epileptics bone operations were added. There were four shoulders in nonepileptics in which one or more dislocations followed operation but in which distinct cures have since been obtained without further operation. One of them may not yet deserve to be put in that class but I am inclined to place it there. This young man was operated on August 30, 1918. In a basket ball game about May 1, 1919, in an attempt to knock down a flying "medicine ball," weighing about 12 pounds, with the hand of the side operated on, he again dislocated that shoulder. After 2 weeks' immobilization in the Velpeau position and avoidance of elevation of that arm as far as possible for 3 or 4 months, he gradually developed normal motion and muscle strength and has had no more dislocations. The following will explain why I believe this patient has as good prospects as any of the next three cases had in the corresponding stage:

Pain and stiffness usually follow the reduction of the first dislocation because of the inflammatory reaction in the injured tissues, especially the torn capsule. After the development of easy recurrences these symptoms do not follow after each reduction because the capsule after the first tear healed long enough to permit the dislocation to occur on slight violence without a new tear so that no inflammatory reaction follows. But after an operation on the capsule some cicatricial contraction of it must result so that another dislocation can not occur without some capsule laceration. Immobilization of the arm at the side after the reduction of the dislocation must be followed by new cicatricial contraction of this again torn axillary portion of

Fig. 1. Patient on whom high excision was done in both shoulders; in right shoulder 4 years ago, and in left shoulder 16 months ago. Operation scar visible. Note absence of atrophy and flail shoulder on both sides and active elevation of both arms.

the capsule, so that if the patient is willing to follow instructions he can add to the strength of the weak portion of the capsule with each recurrence until no more follow. This pathology is supported by the next three cases in nonepileptics. For fuller details of these cases the reader is referred to the above paper in SURGERY, GYNECOLOGY AND OBSTETRICS for January, 1914.

An athletic medical student, operated on November 23, 1909, within the first year afterward, from violent wrenchings of the same shoulder, on two occasions, had the sensations of momentary dislocations. Under date of March 3, 1920, he writes that the shoulder is as strong as it ever was, that he has had no dislocations since the operation, although it has been exposed to violence many times including being thrown from a horse while in the service in France. He may have forgotten the sensations of momentary dislocations of 10 years ago.

An athletic law student was operated on December 20, 1909, and a considerable defect found in the subscapularis muscle where the humeral head had been thrust through it in the first dislocation. He afterward engaged in violent athletic work including heavy weight wrestling and in a wrestling contest dislocated the same shoulder on November 25, 1912. He afterward went back to his gymnasium work. On January 24, 1917, in a boxing contest his opponent gave this shoulder a violent wrench and redislocated it. After the usual prolonged immobilization of the arm at the side, he purposely preserved a moderate degree of limited abduction and since then has done all kinds of athletic work, worked in a lumber camp, swam far from shore, done much boxing and saw much active service as an artillery officer in France, but has had no further dislocations. I see this patient from time to time.

Another strong young man, operated on September, 24, 1913, had a redislocation 7 months afterward when a horse fell on him throwing him to the ground. Under date of February 19, 1920, he wrote that he is capable of doing any kind of hard work and has had but the one dislocation since operation. Word has been received, directly or indirectly from everyone of my living patients within the past eight months, and in each instance it has been requested information be sent promptly of any trouble developing in the meantime.

Failures. A young man who was slender and never enjoyed good health was operated on January 5, 1913. On January 17, 1914, he had another dislocation from slight violence and a second dislocation on October 14, 1914. On October 29, 1914, a second capsule operation was done on this shoulder and on January 3, 1916, the same shoulder was redislocated from slight violence. I detected nothing in either operation which would account for the failures. This is the only nonepileptic case which was operated on the second time.

A strong young man, operated on May 25, 1918, left the city for his home in a distant state in about 2 months and never returned. On August 5, 1919, while repairing an automobile in reaching for a difficult position he wrenched and dislocated the same shoulder. He did not immobilize the arm and soon had another dislocation and after this more of them.

Epileptics. Of the 18 shoulders in epileptics the capsule operation was done in 17, in one only a high excision (Figs. 1 and 2). In 11 of the capsule cases and in the high excision, there have been no dislocations since the operation in each.

a. *b.*

Fig. 2. Showing how much of humeral heads remained after the high excisions. The lower heavy straight lines mark usual level at which head is excised for this condition because that much of head is thought to leave joint in a dislocation. Upper heavy lines mark level of anatomical neck. The results in this case prove that the high excision removed enough of the heads to stop the dislocation. There has probably been some growth of bone from the cut end of the humerus since the operation. *a*, Right shoulder; *b*, left shoulder.

In the six remaining cases dislocations followed the first capsule operation. In one of the early cases dislocations followed the second capsule operation after which the patient was lost track of. In another case they followed three capsule operations when a high excision was done (October 28, 1916), after which there were no more dislocations. The first capsule operation in one case showed a very defective glenoid cavity which was reshaped in a second operation, 9 years ago, after which there were no more dislocations and the function of the joint became almost normal. In a fourth case after a capsule operation, prolonged immobilization in the Velpeau position in a plaster cast was tried with the object of forming firm cicatricial union. When the cast was removed it was found that the head had been out of the socket probably for some time. During a second capsule operation it was found that with the arm at the side, the humeral head would drop out of the socket into the usual dislocated position. Permission for an excision had not been obtained and the capsule operation had to be relied on again, the head being kept in the glenoid cavity by maintaining the extreme Velpeau position. This position was held by a cast for 3 months. The cast has been off for 6 months and the patient has had repeated convulsions but no more dislocations, thus far. In a fifth case a second capsule operation was done October 11, 1919, and proved a failure. Upon the reduction of the first dislocation following this second operation, the arm was fixed in a plaster cast in the Velpeau position with the same purpose as in the four nonepileptic cases already mentioned as cured without a second operation. This cast was not removed for 3 months, and 3 months have passed since it was removed. Although the patient has had numerous convulsions since then he has had no further dislocations.[1]

The high excision performed in both shoulders of the same patient (Figures 1 and 2) deserves special mention. In my first epileptic case the dislocations recurred after two capsule operations probably because of the powerful convulsions and a large defect in the humeral head, and I then concluded that only an excision or an arthrodesis would stop the recurrences. I had in mind the ordinary

[1] This shoulder was again dislocated about December 1, 1920. An interne and myself on different days, each succeeded in reducing the dislocation, but neither could maintain the reduction when the reducing force was removed. The normal retentive capacity of the joint had, evidently, been lost by excessive bony defects at the usual sites. The high excision (Fig. 2) was performed December 13, 1920.

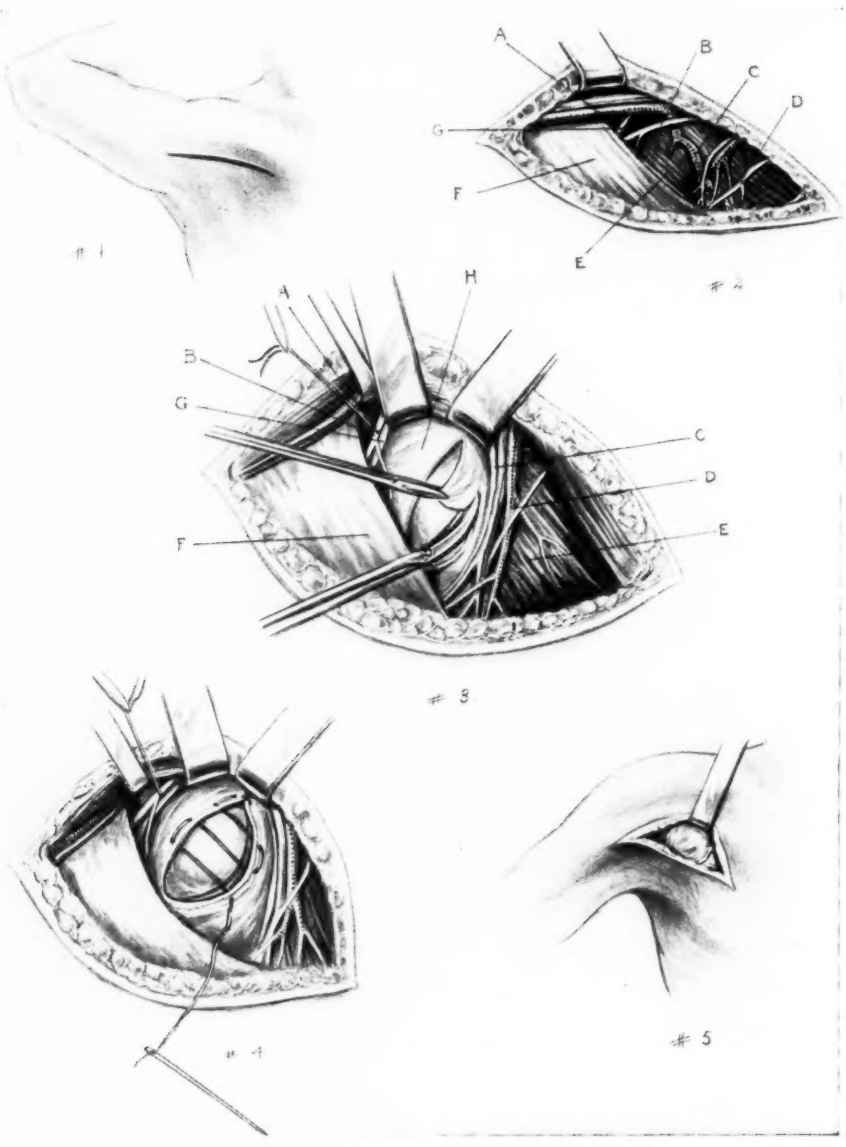

Fig. 3. Showing the essential features of the capsule operation done through an incision posterior to the axillary vessels and nerves. It will be necessary only to locate, expose, and especially guard the circumflex nerve. *a*, Axillary artery and vein; *b*, circumflex nerve; *c*, subscapular artery; *d*, subscapular nerve to the latissimus dorsi muscle; *e*, subscapularis muscle; *f*, latissimus dorsi muscle; *g*, posterior circumflex artery; *h*, capsule.

excision through the surgical neck of the humerus which removes the attachments of the very important rotator muscles and almost always leaves a flail shoulder-joint, the functional result being very undesirable. The excision in this patient was done through the anatomical neck or still higher but removed all of that part of the head which projects out of the socket in a dislocation so that afterward a dislocation became impossible. The groove which I have always found in the posterior part of the humeral head when I looked for it marks clearly how much of the head projects from the socket because it is made by the pressure of the anterior glenoid margin when the head is in the dislocated position.

The surgeon who attempts for the first time any of the capsule operations must depend for guidance on descriptions of the operation selected, because there are no satisfactory illustrations in the literature, so far as I know. For a description of the anterior axillary operation the reader is referred to a paper in the *American Journal of the Medical Sciences* for March, 1909; for one of the posterior axillary operation to SURGERY, GYNECOLOGY AND OBSTETRICS for January, 1914; and for one of the high excision of the humerus (with illustrations), to the *Annals of Surgery* for October, 1917. Figure 3 will amplify the description of the posterior axillary capsule operation.

Most surgeons have preferred and will probably continue to prefer the deltopectoral capsule operation. I have now done all three capsule operations but much prefer the posterior axillary. Only one surgeon, Telford (*Lancet*, London, August, 3, 1912), showed a preference for the anterior axillary operation. In a personal communication about 4 months ago, Leonard W. Ely, San Francisco, expressed much satisfaction with the posterior axillary operation. He says "It is a beautiful operation and I found it almost bloodless."

SUMMARY OF RESULTS

The wearing away of the bony parts from pressure contact during the dislocations, if nothing else, will prevent a complete return of the joint to the normal. Therefore, the terms success and failure as employed here can have only a relative meaning. It is also impossible to decide upon a time limit for a positive cure.

Of the 24 shoulders in nonepileptics, in all of which only the capsule operation was performed, in 18 there have been no dislocations since the operation, done in the most recent case 3 months ago and in the first nearly 13 years ago. Four more cases, in which only one operation was performed, may fairly be classed as cures, making 22 successful results from the capsule operation. Two cases have been failures, one after two operations and one after one operation.

Of the 18 shoulders in epileptics the capsule operation was done in all but one in which only a high excision was performed without any further dislocation. In 11 cases one capsule operation in each was completely successful after 4 years in the most recent case and 11½ years in the first. Of the remaining 6 cases, 1 was successful from reshaping the glenoid cup after a failure by one capsule operation, and 1 was successful from a high excision after three capsule operations had failed. This operation in my opinion, will stop the dislocations in any case but impairs the joint function considerably. Two recent cases show encouraging results after the second capsule operation. (See above foot note concerning one of these.) Two cases are classed as failures, one after two capsule operations and one after one capsule operation had been performed.

CONCLUSIONS

The pathology of recurrent dislocation of the shoulder concerns the skeleton and the essential problem is to repair the defect in the skeleton. This involves the bony and ligamentous portions of the joint. Usually it will be sufficient to repair the capsule lesion, rarely the bony defect must be attacked. In proof of this the above results are offered. Further study and experience should improve them.

A PERINEAL OPERATION FOR REMOVAL OF STONE IN THE LOWER END OF THE MALE URETER

By OSWALD SWINNEY LOWSLEY, A.B., M.D., F.A.C.S., New York
From the Urological Department of Bellevue Hospital, New York

THE accessibility of the lower end of the ureter by means of the perineal route was impressed upon me particularly while performing a rather difficult seminal vesiculectomy. The tissues were so matted with adhesions that it was deemed advisable to identify the ureters for their safety. This was easily accomplished. The thought immediately occurred to me that a stone lodged in the terminal inch of the ureter could be more easily removed *per perineum* than by abdominal incision.

A review of the anatomy of the male pelvis and careful dissection on the cadaver resulted in the development of the following operation.

TECHNIQUE

The patient is placed in the exaggerated lithotomy position with the hips well elevated. The perineum, scrotum, and penis are prepared in the usual manner.

A horseshoe-shaped incision is made in the perineum, the curve being above the bulbous portion of the urethra and the ends well to each side of the rectum.

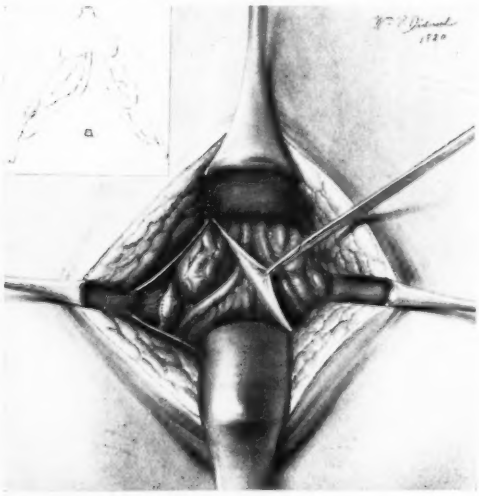

Fig. 1.—Exposure of right seminal vesicle with stone in ureter just above its tip.

The incision is then deepened, central tendon severed, and incision carried downward hugging the urethra, until the apex of the prostate is reached.

It is well to have a sound in the urethra to act as a guide.

At the apex of the prostate the recto-urethralis muscle must be incised to avoid tearing into the rectum, which might result if blunt dissection were attempted (Fig. 1). The levator ani muscle is then separated from the prostate exposing the posterior surface of that organ, recognized by the glistening fascia of Denonvilliers which covers it. By continually dissecting upon the genito-urinary organs one avoids the rectum.

A blunt-toothed retractor is then fixed at the base of the prostate gland as shown in Figure 2, the sound having been removed from the urethra. Traction upon this pulls the prostate and seminal vesicles forward. It is well at this point to elevate the foot of the table considerably, as the wound is quite deep and the ureter is on the roof of the wound. The intervesicular fascia[1] is then incised and drawn laterally, exposing the ampulla of the vas and the seminal vesicle of the effected side. The dissection is continued deeper, the rectum being held down by a long curve-backed retractor (shown in Fig. 2). The ureter is found emerging just above the very tip of the seminal vesicle. It is isolated from the surrounding tissues by blunt dissection; the seminal vesicle being freed and lifted up slightly. A tape is then passed around the ureter, beyond the site of the stone if possible. Longitudinal incision is made in the ureter directly over and below the stone, which is removed with bulldog forceps. It is extremely difficult to insert a suture into the ureter;

[1] Anatomy of the human prostate gland and contiguous structures. Surg., Gynec. & Obst., 1915, xx, 188.

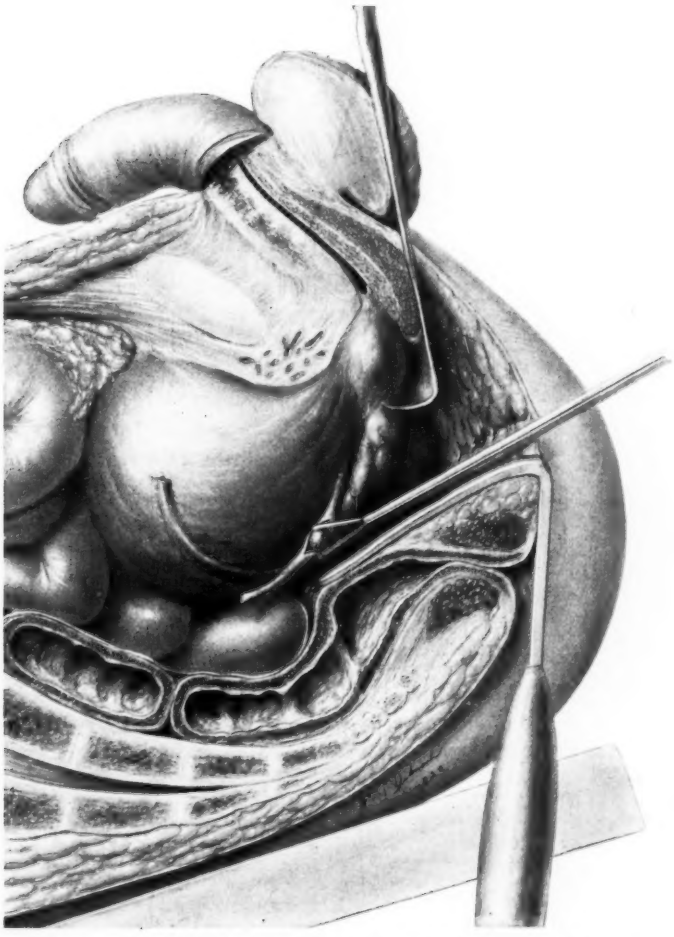

Fig. 2. Sagittal view showing removal of stone and retraction of tissues.

therefore one must be content to insert a cigarette drain to the point of incision.

Closure is accomplished by drawing the separated levator ani fibers together by one or two plain catgut sutures and the skin is closed by silkworm-gut.

Dressings should be changed frequently during the first few days as there will be a considerable leakage of urine through the perineal wound. In order to hasten the healing of the ureteral wound a catheter may be passed into the ureter by means of the cystoscope and left in position for a day or two.

The description of a case in which a ureteral calculus was successfully removed by the perineal route follows.

J. S., age 41, admitted to Ward K4, Bellevue Hospital, suffering from chills, fever, general weakness, and cloudy urine. The family history reveals no tuberculosis, cancer, or chronic diseases. The patient has had the usual children's diseases: measles, mumps, whooping cough. In 1907 he had a nephrotomy (right side). Five years ago he had chills, fever, and sweating which lasted only a short time. One year ago he had considerable pain in left kidney region. For the past year he has had frequent attacks similar to the last one, *i. e.*, chills,

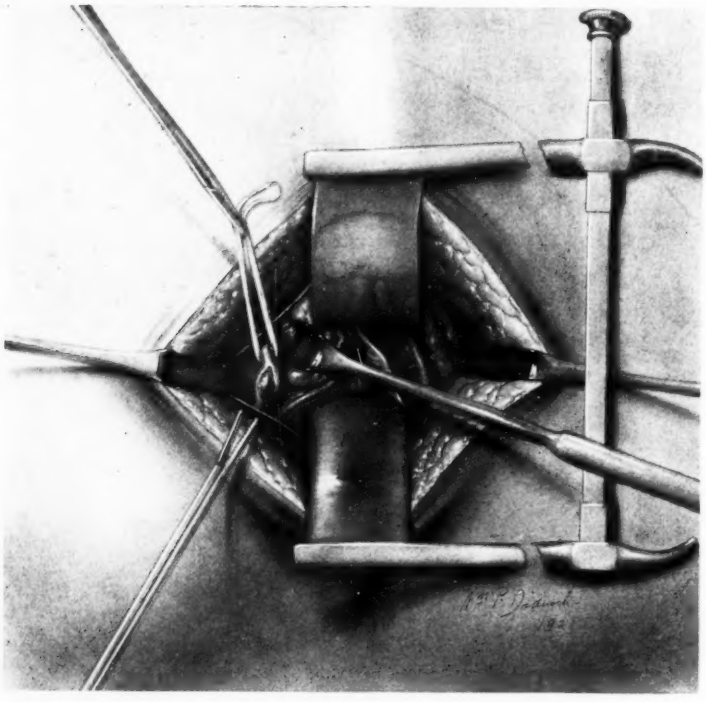

Fig. 3. Right seminal vesicle held to one side and ureter opened over stone.

fever, drenching sweats, with very cloudy urine. He has lost 20 pounds in the past 3 weeks and complains of general weakness. He voids three to four times daily and occasionally once at night. He has no difficulty in urinating. About 7 years ago he passed small stones. He had gonorrhœa 15 years and 5 years ago.

About 12 days ago he had last attack of chills followed by fever, drenching sweats, and prostration. He states that the urine has been very cloudy before attack and becomes clear subsequently. He has experienced no pain with these attacks, but has felt completely "played out" since last attack.

Physical examination. The patient is a male adult, who is up and around, but has an anxious expression and appears ill. He is somewhat anæmic. His eyes react to light and accommodation. Teeth are good. Tongue is clean. Throat is negative. Neck is negative. The chest is symmetrical. There is no enlargement of heart, the sounds are clear but rather distant. There is good resonance throughout, with no evidence of pulmonary disease. The right kidney is palpable on ballottement, no other organs or masses felt. There is a scar of old operation in right loin. There is moderate left varicocele, but penis, testicles, and epididymides are normal. The extremities show no abnormalities. Knee jerks are absent; no Babinski, cremasteric. The abdominal reflexes are normal. The biceps are absent. Rectal examination shows the prostate slightly enlarged with some induration; vesicles palpated, slightly enlarged.

Provisional diagnosis: pyonephrosis, varicocele.

Urinalysis, May 12, 1920. Turbid; straw color; specific gravity 1.004; acid reaction; albumin, 1 per cent; glucose 0; 200–300 pus cells per low power field (not centrifugalized).

X-ray reyorts. May 15, 1920. There are numerous calculi of the left kidney, varying in size from ¼ inch to 1¼ inches in diameter. This kidney is markedly enlarged.

Cystoscopic examination by Dr. Stevens, on May 17, 1920. Posterior wall of bladder poorly seen, apparently chronically inflamed, vessels not visible. Ureteral orifices are in normal position and of normal contour. The catheters pass with no noticeable obstruction to pelvis of both kidneys. Clear amber urine flows from right kidney; very turbid (smaller amount) from left.

Phthalein injected in vein; color appeared from right side in 3½ minutes. Collection made for 10 minutes. X-ray taken with catheters in ureters.

Left lower pole is at the level of the transverse process of the fourth lumbar vertebra. The lower pole of the right kidney is at the same level. There is a calcareous area 3/8 inches in diameter lying above the inner side of the right ischial spine, a corroborative examination of which will be made.

Note by Dr. Lowsley, May 18, 1920: The lower pole of left kidney is felt. The right not felt. There is moderate left varicocele; epididymides and testicles normal. The prostate is of usual size. The right border is masked by adhesions, the left is clear. Both seminal vesicles are enlarged.

May 19, 1920. An opaque catheter directly overlies a calcareous area of the lower right ureter. A calculus of the right kidney is present as previously described.

Cystoscopy by Dr. Lowsley, May 22, 1920. Bladder mucosa is normal in appearance. A wax bulb is passed with difficulty into right ureter to kidney pelvis (some of wax scraped off by cystoscope); catheter passed to left kidney without obstruction. X-ray taken at two angles on same plate. No wax on catheter when it was examined after cystoscopy (right ureter). Left catheter did not work, no urine or phthalein coming through in 30 minutes. Specimens were collected for microscopic and phthalein tests. Bladder catheterized after cystoscopy for left side specimen and leakage around right catheter.

Ureteral specimens:

	Right	Left
Amount	10 cubic centimeters	6 cubic centimeters
Phenolsulphonephthalein	5 per cent	very faint trace
Urea	0.7 per cent	0.1 per cent
Wet specimen	no pus	loaded with pus
Stained specimen	no organisms no tubercle bacilli	no organisms no tubercle bacilli

X-ray examination, May 25, 1920. There is present a large cuneiform calculus in the pelvis of the left kidney. There are numerous small calculi in cysts in the lower pole of the left kidney. There are also some small calculi in an encysted area in the upper pole. The left kidney is hydronephrotic, the right kidney is also markedly enlarged. There is an oval calculus 1/4 inch in length in the lower part of the right ureter, 1½ inches above the entrance of the bladder.

The patient was operated upon by the method described above with the exception that a long Young's tractor was used to draw the bladder down into the wound.

The drain was removed first day. The patient was up in a chair on third day after operation. There was considerable leakage through fistula in perineal wound. Except for this tract, wound was healing nicely. Stitches were removed sixth day. Eighth day catheter No. 6 F. was passed with difficulty past the incision in ureter and left in position for 4 days. A considerable portion of the urine passed through the catheter and very little through the fistula.

Fig. 4. Closure with drain inserted to point of ureteral incision.

The left kidney was removed by Dr. Lowsley, June 8, 1920; and patient was out of bed tenth day, home cured on twenty-first day, and reported to return clinic July 15 and 22 and was well and had gained 15 pounds. Patient seen on January 28 and found to be in excellent condition. Ureter again dilated.

LITERATURE

Keyes, p. 852, states:

In the female, large stones caught just external to the bladder may be reached by incision in the vaginal vault; but if the stone is at all movable it is fixed in the position with great difficulty and when the incision in the vaginal vault has been made the stone will be found to have slipped out of reach up the ureter. For small stones, therefore, even in the female, the abdominal route is preferable.

Fenwick, *Edinburgh Medical Journal*, 1898, n. s. iii:

I approached the stone through a transverse perineal incision. I had no hesitation in adapting this route for it had become familiar to me in resecting pieces of vesiculæ seminales, etc. . . . With the aid of a narrow, long-tongued retraction I was able to dissect between the rectum and the lower urinary tract, every step of the route being illuminated by a Washington-Isaac search light. I rapidly reached the ureter, being guided to it by feeling the stone in it forced within reach of my finger by the pressure of the dresser's hand upon the abdomen. A clean incision into its long axis released a quantity of clear urine and the stone which weighed 2½ drams. The latter resembled a small peach stone in size and appearance. On inserting the finger into the ureter, it was evident that the calculus had been lying in a dilation of the canal for the caliber was here about

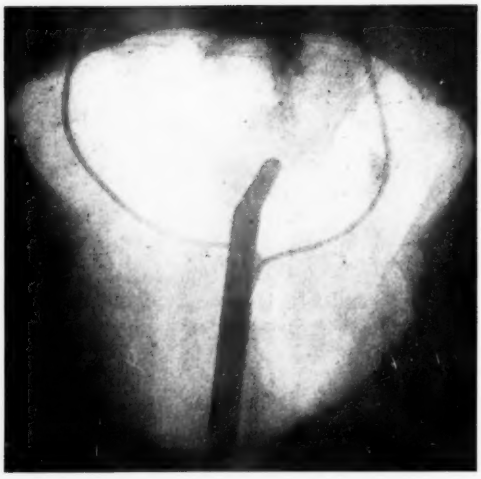

Fig. 5. Roentgenogram, J. S., May 17, 1920, showing stone in right ureter lying beside shadowgraph catheter.

Fig. 6. Roentgenogram, J. S., May 22, 1920. Two exposures on same plate. The X-ray tube was moved 1 inch laterally. This shows calculus moving exactly with catheter. If the shadow were in front or behind ureter there would be a discrepancy.

an inch across. I passed a thick, windowless drain-tube up toward the kidney, and stitched its lower end into the perineal wound, providing thus for an easy route from the ureter into the perineum. . . . . The stone did not obstruct the passage of urine from the kidney because of the deep flutings on the surface.

Henry Morris, *Edinburgh Medical Journal*, 1898, n. s. iii:

When a stone is impacted near the lower end but too far off to be recovered through the bladder or the vagina the sacral route should be employed. In the male the prerectal route is available; thus M. H. Fenwick successfully removed a calculus the size of a small apricot stone from the ureter 2 or 3 inches from the bladder by dissection between rectum, etc.

Extraction of a stone impacted in the vesical part of its course or in a ureteral pouch should be effected *per urethram* in the female, if possible, and by perineal or suprapelvic cystotomy in the male. These two were advocated by me in 1884. The perineal incision is said to have been practiced by Desault and Garengect. Unless the patient is very thin and the pelvis shallow the suprapelvic operation is to be preferred to the perineal. Tuffier has removed a ureteral calculus in this manner.

Hugh Young, *Transactions Southern Surgical Association*, 1902, xvii, 169, states:

The perineal prerectal route has only been employed by Fenwick who made a transverse incision in the perineum, separated the rectum from the prostate and thus exposed the ureter with a calculus impacted in the juxtavesical position. The stone was removed through a longitudinal incision. The ureter was drained. . . . Fenwick thinks this the method of choice where the calculus is low down in the ureter. Regnier tried to reach the ureter this way but had to employ the iliac route. Calculus of the deep pelvic ureter in the male has received much attention and there is still little unity of opinion in the literature as to the proper method of attacking it. . . . I cannot agree with Fenwick and Morris, authorities though they be, in considering it the method of choice in the male, but feel convinced that the iliac route is the only justifiable route.

Ricketts, *St. Louis Medical Review*, vi, "Summary of Method of Reaching Lower Ureter:"

The routes which have been proposed to the present for operation upon the lower ureter are:

1. The intravesical, suprapubic, perineal, and transurethral;
2. Intrarectal or transrectal used by Cesi; patient died;
3. Iliac or para-Poupart incision;
4. Sacral route, Cabot 1892, worked on cadaver;
5. Pararectral route, Morris, incision from a point opposite third sacral spinous process to point 1½ inches below the tip of coccyx;

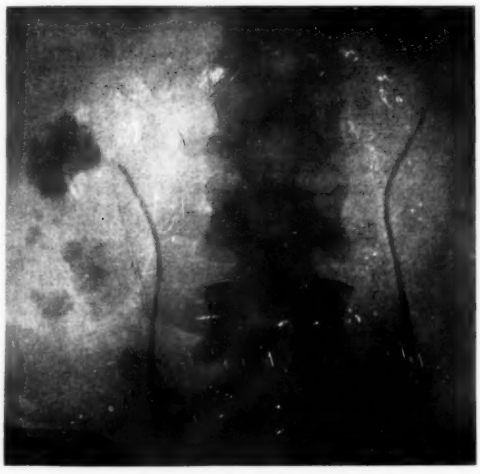

Fig. 7. Roentgenogram, J. S., May 22, 1920, showing stones in left kidney.

Fig. 8. Stone crushed in removal from right ureter by perineal route—case J. S.

6. Perineal route, Fenwick—used where the stone was felt through rectum;

7. Transperitoneal route, too dangerous to be attempted.

CONCLUSIONS

1. No conclusions can be drawn from a single case. The lesson taught by this particular case seems to be that removal of stone by the perineal route should not be attempted if (a) the stone is more than 4 centimeters from the bladder; and (b) it is not fixed in its position.

2. Stone impacted at the point where the ureter joins the bladder wall is accessible *per perineum* unless the patient is obese.

3. Provided a stone is successfully removed from the ureter by the perineal route the patient may be allowed out of bed after the second day and the downhill drainage would seem to be a decided advantage in that the chances of thick scar formation around the ureter are less.

The advantages of this operation are:

a. This portion of the ureter is more accessible *per perineum* than by any abdominal operation.

b. The patient may be allowed out of bed 2 days after operation.

c. The downhill drainage from the incised ureter prevents absorption of urine and deleterious results from concomitant infection which frequently accompanies urinary lithiasis.

d. Chances of wide infection of tissues around incision in ureter and subsequent stricture of ureter are much less.

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The author wishes to express his gratitude to Dr. E. L. Keyes, Jr., upon whose service at Bellevue Hospital the operation was performed.

TISSUE RESISTANCE IN MALIGNANT DISEASE

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ACCURATELY to define anything is to give in brief form so succinct an account of the object or process that only the details have to be filled in. Moreover such a definition should admit of no exceptions. So far no lexicographer has provided us with a satisfactory definition of malignant disease, for the good reason that we know little of the essential nature of malignancy, and without complete knowledge the perfect definition is impossible.

The sum and substance of all such definitions, however, is that a malignant growth consists of cells possessed of abnormal and apparently unlimited power of multiplication, that these cells may enter the lymph or blood stream, and, when planted in suitable soil, reproduce the original growth from which they sprang. The cells of a malignant tumor may be termed the bolsheviki of the body, for they know no law, pay no regard to the commonweal, serve no useful function, produce disharmony and destruction in their immediate surroundings, and scatter the seeds of future trouble in distant parts. It is to some peculiarities in the behavior of these seeds of trouble that I wish to direct attention in the present paper.

The property of discharging cells into the general circulation is by no means confined to neoplasms. In an organ where the parenchyma cells come into very close relationship with thin-walled blood-vessels these cells may become migratory. Cells of the chorionic villi, the liver, and other parenchymatous organs have been found in the lungs. In that most remarkable condition known as general thyroid malignancy, nodules exhibiting typical and apparently normal thyroid structure are found scattered throughout the skeleton, although there may be no discoverable tumor in the thyroid itself.

It is in malignant tumors, both sarcomata and carcinomata, that the cells show their greatest tendency to become detached into the blood stream. It is but natural that tumors should vary in the degree to which they possess this deadly property. Anyone familiar with the histological picture in epithelioma of the skin and chorio-epithelioma of the uterus will readily understand why propagation through the blood is extremely rare in the former and very common in the latter.

It is a mistake, however, to imagine that the formation of metastases is merely a matter of discharging into the circulation, cells with malignant properties. There is in addition the question of tissue predilection. It is common knowledge that tissues differ in their liability to metastases. As Virchow first pointed out those organs such as the breast, the stomach, or the uterus which are frequently the site of primary growths, are as rarely the seat of metastases, and the reverse also holds true.

Many of the peculiarities of distribution of secondary growths can no doubt be explained

on anatomical grounds, and it is easy to understand why the liver should be so frequently involved in neoplasms of the alimentary tract; the lungs, in those of the uterus. Much that is mysterious in the distribution and behavior of metastases cannot, however, be explained in this simple manner. Tumor cells must be carried in large numbers to the heart, the spleen, and the muscles, yet why should secondary growths in the two former be rare, in the latter almost unknown? It is not sufficient that tumor cells be discharged into the circulation for a metastasis to be formed; of paramount importance is the relation established between the arrested cells and the new environment in which they find themselves.

This truth is well recognized in the case of metastatic abscesses in infectious disease. A vegetation on the heart valves may spray out innumerable streptococci into the blood stream, but most of the seed falls among thorns or by the wayside, and only that which falls on good ground brings forth fruit in the shape of metastatic abscesses. In other tissues the conditions are not favorable to bacterial growth. Recent work has shown the great influence which the reaction of the medium exerts on bacterial growth. In the case of the more delicate bacteria a slight alteration in the reaction may completely inhibit the growth. The highly acid environment which the muscles provide may thus well prove inimical to bacteria struggling to gain a foothold.

The analogy between the metastases of infections and those of malignant disease is an enticing one, but Darwin's warning that analogy is a deceitful guide may well give us pause; for the nature of the metastases is entirely different in the two cases. In the first the bacteria are carried to a new site, and there bring about certain proliferative and destructive changes on the part of the tissues, while in the second it is the newly arrived cells which proliferate, not those of the affected part. In both cases, however, we are confronted with the striking phenomenon of tissue predilection, and it is possible that information gained regarding the one may throw light on the nature of the other.

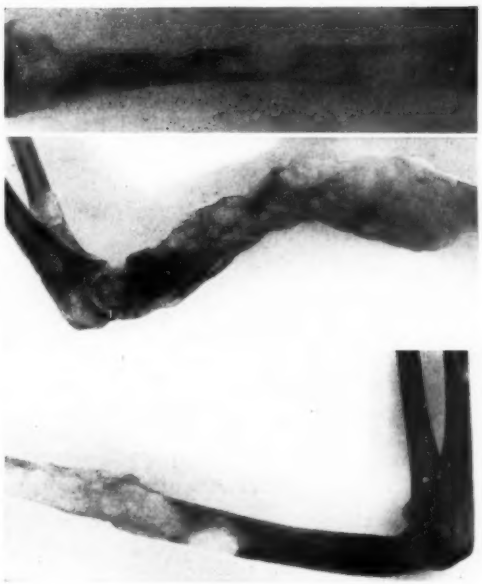

Fig. 1. Case 1. Considerable involvement of right humerus, September, 1916.

Fig. 2. Case 1. Right humerus almost entirely replaced by carcinomatous tissue. Pathological fracture. Smaller deposits in bones of forearm. October, 1917.

Fig. 3. Case 1. Metastases in left arm. October, 1917.

It is more than probable that there exists a preliminary interval during which it is not possible for secondary growths to be set up, a refractory period in which the tissues are being sensitized and prepared, it may be by the action of ferments produced by the tumor cells—a period, that is to say, of comparative immunity.

The following three cases, for the clinical details of which I am greatly indebted to Dr. J. E. Lehmann, illustrate some points in tissue immunity.

CASE 1. Mrs. M., age 40, a stout well-nourished woman, was admitted to hospital in the fall of 1915 complaining of a lump in the breast. A diagnosis of carcinoma was made, the breast was removed and was found to contain a scirrhous cancer. The axillary glands were also involved. The diagnosis was confirmed by microscopic examination. Early next year she returned complaining of pain in the right arm. A roentgenograph was taken and unmistakable evidence of metastatic involvement of the humerus was discovered.

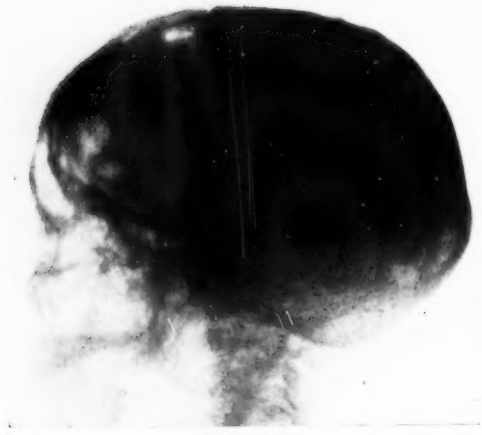

Fig. 4. Case 1. Numerous metastases in skull. October, 1917.

In September of that year (1916) she again came under observation and the X-ray picture showed extensive involvement of the right humerus, the right femur, and the pelvis.

She was not seen again until October of the following year, when she was admitted to hospital in a miserable condition. She was bed-ridden, unable to feed herself, and had spontaneous fractures of both upper arms. Over the vault of the skull were numerous firm nodules. Numerous X-ray studies were made, and an involvement of the skeleton discovered of most remarkable extent. It almost appeared as if not a bone in the body had been spared (Figs. 1, 2, 3, and 4). There were widespread metastases in the skull (the nodules already referred to), the humerus, radius, ulna, femur, tibia, and fibula on both sides, the pelvis, and the small bones of the hands and feet. The fractures of the arms were due to extensive involvement of both humeri.

Arrangements were made for the patient to be sent to a home for incurables in another city, but as that institution was full a delay of 4 months ensued before she could gain admission. During that time the clinical picture underwent a most extraordinary transformation. The nodules in the head disappeared, the fractures of the arms united, strength returned to the legs, she was able to sit up and knit, and by the time she left hospital she was walking about the ward with a little assistance.

Here is one of those singular cases which are occasionally encountered in which the natural defenses of the body triumph over the forces of malignancy. Such an outcome is not rare in slowly growing primary tumors in old people, and the failure of metastases to form owing to the unsuitability of the environment is an everyday occurrence. The disappearance, however, of metastases so widespread as to involve almost every bone of the body and so far advanced that spontaneous fractures had occurred is a phenomenon as startling as it is incomprehensible. It proves beyond cavil that the body may acquire at least for a time an immunity to malignant disease.

Case 2. Mr. W., age 71, had always enjoyed good health until 1913. In that year a pigmented warty growth developed on the plantar surface of the heel. It was removed, found to be a melanoma, and soon recurred at the margin of the scar. It continued to grow and was removed again in 1916, but again recurred.

In 1917 the glands in the groin became enlarged, and have continued to increase in size until now they form a pigmented mass as large as the fist.

The primary growth was removed for the third and last time in 1918.

At the end of 1919 pigmented spots began to appear on the leg between the knee and ankle. These are raised, firm nodules, about the size of a ten-cent piece, some of an intense jet black, others showing little spots of black here and there on the surface. A few months later small pigmented spots appeared on the chest wall and the side of the nose.

At the present time (August, 1920) the leg presents a most classical picture of melanotic sarcoma (Fig. 5), there is a huge pigmented mass in the groin, a marked collateral circulation on the abdominal wall suggests pressure on the inferior vena cava, and a spontaneous fracture of a rib on the right side of a month's standing may indicate involvement of bone.

Most important of all, during the 7 years that the patient has suffered from melanotic sarcoma, for 6 he has been in perfect health and vigor, able to do a full day's work. It is only during the last year that he has not felt strong enough to work, and he has not been confined to bed for more than 2 months.

Here is a patient who, although suffering for 7 years from what is regarded as one of the most malignant of tumors, during 3 of which years there was distant glandular involvement with blood spread for nearly a year, yet remains in excellent health for 6 years and has every prospect of living out the seventh. Such a patient must have a wonderfully high relative immunity which is only now breaking down.

At the same time the general conception of the malignancy of melanomata, as gathered

Fig. 5. Case 2. Metastatic growths of skin in various stages of development.

from statements in the textbooks, is unduly gloomy. As Sampson Handley puts it, the prognosis has been painted in tones as black as the characteristic nodules. It is true that dissemination is terribly rapid in many cases and death may follow in a few months. In others, however, the tissue immunity is sufficient to allow of successful operative interference.

Very rarely the reaction on the part of the tissues is sufficient, temporarily at least, to destroy the secondary growths. Such a case is that reported by Pearce Gould, and referred to by Handley in his Hunterian lectures on melanomata. A small congenital mole was removed from the chest, after it had been growing larger for 3 months. Removal was soon followed by the appearance of tiny nodules in and under the skin. When the patient came under the observation of Gould 9 months later the nodules were scattered over the greater part of the body. A month later it was found that no new nodules had appeared, and that most of those already present were very much smaller. So also were the enlarged lymphatic glands. In the course of a few weeks all the nodules had disappeared with the exception of two small ones. The patient gained considerably in weight. Six months later cutaneous nodules again appeared, and the patient soon died, after being confined to bed only 3 or 4 days.

As in the present case, spread by lymphatic permeation usually precedes blood spread by a considerable period, and if the operation be conducted along the lines advocated by Handley, with removal not only of neighboring glands but of the intervening lymphatics which are also implicated, the patient has a fair chance of life.

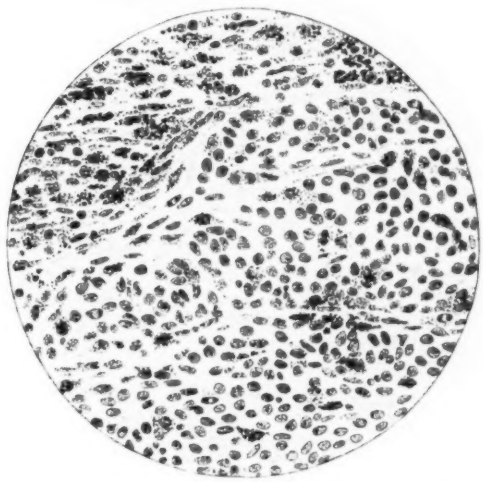

Fig. 6. Case 3. Melanotic sarcoma showing round and spindle cells many of which are loaded with melanin. One mitotic figure is seen.

Case 3. Mr. P., a healthy farmer, age 38, presented himself in March, 1918, with a mass in the axilla on the right side. It had been there since the middle of the previous year, but had troubled him so little that he did not leave his work to come into the city to have it treated. Microscopic examination showed it to be a typical melanotic sarcoma containing a large amount of pigment (Fig. 6). He gave a history of having had a growth of unknown nature removed from the interscapular region 7 years previously.

He made a rapid recovery and did a full summer's work on his farm. In the fall several blackish nodules appeared on the skin of the chest and anterior abdominal wall. These were excised, and proved to be identical in microscopic structure with the mass from the axilla. His health remained unimpaired, but realizing the seriousness of his condition he insured his life as a first class risk.

In June, 1919, he reappeared in hospital suffering from an acute abdominal condition which proved to be an intussusception. At the operation an enlarged gland was found close to the intussusception, and probably the cause of that condition. Sections showed the structure which had already become so familiar.

In September he presented himself again complaining of sore throat, and it was found that the tonsils were converted into two large black masses which were removed with perfect ease. Needless to say they were the seat of melanotic sarcoma.

The patient returned to his farm and continued to work throughout the winter, but in the spring he succumbed rather suddenly, the exact details not being available. He thus enjoyed nearly 3 years of robust health, punctuated though they were with numerous operations.

This case is remarkable for the series of metastases which appeared one after the other in so dramatic a fashion. Although the patient must have been riddled with melanomata he yet enjoyed perfect health, worked hard as a farmer, and actually passed for life insurance.

That a partial immunity against malignant disease may exist is shown by the cases just described. It is possible for the patient to remain in a condition of apparently absolute health while metastases are being formed in a widespread manner throughout the body, very much as if non-pathogenic bacteria established themselves in foci here and there without affecting the general health.

Not only may the metastases be held in check, as it were, by the defensive forces of the body, but they actually may recede and disappear, as in Case 1. There can be no explanation for such behavior as long as our ignorance of the essential nature of neoplasms is so profound. At the same time it is more than probable that in some instances at least the behavior of the metastases is governed and controlled to some extent by the primary growth. Thus it is a recognized fact that removal of the primary tumor in chorio-epithelioma may be followed in exceptional cases by disappearance of the secondary growths in the lung.

The fate of a metastasis depends not only on the proliferative activity of the tumor cells, but also upon the behavior of the tissue in which they are implanted. This can be studied very satisfactorily in experimental transplantation.

When a tumor, such as a breast carcinoma in a mouse, is transplanted into a series of mice, it will die in the majority of cases, but in about 5 per cent the transplant will take. After a series of transplantations the tumor becomes so adapted that it will grow in nearly every case. The series of changes that such a graft undergoes is briefly as follows: At the end of 24 hours a connective-tissue reaction can be observed around the graft, the fibroblasts proliferate, and new capillaries are formed. At the same time the stroma of the graft begins to degenerate, and by the third day this degeneration is complete. The new granulation tissue invades the graft, vascularizes it, and by the end of the second week a completely new stroma is formed. The fate of the graft depends entirely on the formation of this new stroma. If this does not take place the graft will die. In an immune animal this new stroma is not supplied, in a susceptible animal it is.

Murphy and his co-workers are of the opinion that the essential immunity mechanism against carcinoma is the proliferation of lymphocytes so frequently seen in the neighborhood of a malignant growth. He has shown experimentally not only that a strong dose of X-rays by injuring the lymphoid tissue of the body, may render the animal more susceptible to the inoculation of tumor fragments, but also that by stimulating the lymphoid tissue by a small dose of X-rays the animal may be made correspondingly immune.

In some cases the new tumor after growing for some time may die. In such a case it is impossible to re-inoculate the animal, which is now immune. Similar immunity can be produced by the inoculation of normal living tissue or of red blood corpuscles. The tissue, however, must be from the same species of animal. Rat tissue will not immunize a mouse. Unfortunately immunity to a growing tumor has not so far been produced, nor can the immunity be transferred passively to another animal.

These facts certainly throw light on the general question of immunity to malignant disease, and the day will come when they can be applied to the production of immunity in man. Until that day dawns we must still regard the knife as the principal weapon against this greatest scourge of humanity.

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RECONSTRUCTION SURGERY AND ITS APPLICATION TO CIVILIAN PRACTICE[1]

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THE term reconstruction surgery has found its way into surgical thinking and writing almost entirely since the recent great war. It implies the surgical attempt to "make over" the defects and deformities of the human frame, resulting from injury and disease. In a very small way most of the problems of war surgery had been observed by many orthopedic surgeons in civilian practice, but the war presented in wholesale fashion an opportunity to study, and attempt to meet satisfactorily, problems which the surgical profession has never hitherto in the world's history been asked to cope with. It is a matter for congratulation that the surgeons, with outstanding leaders and a band of enthusiastic followers, have been successful to a very great degree in overcoming these problems and thus reclaiming to self support and comfort a host of disabled men who would otherwise have been derelicts, dependent upon their grateful countries for their very subsistence. It is with the hope that the lessons learned in dealing with these casualties of the fearful struggle may be made permanent for the treatment of disabilities of civilian life that this paper is presented.

One of the most important lessons learned, and therefore presented first for your thought, is the emphasis placed upon *ultimate function* in the individual, rather than restoration of the contour and anatomical structure of a part. An example which readily comes to mind is the improved function of an arm in a case of loss of the shoulder-joint, which comes by aiming at and securing an ankylosis of the shoulder in good position rather than attempting an arthroplastic operation to restore motion of this joint.

The subject of reconstruction surgery is so comprehensive as to make it impossible to present it in a single paper, but some of the outstanding features will be considered as they relate to the various structures of the extremities: (a) the bones, (b) the joints, (c) the muscles and tendons, and (d) the peripheral nerves.

THE BONES

Bone sepsis. One of the greatest problems in the surgery of the war was that of bone infection. It primarily menaced the life of the patient, and ultimately the function of the limb. That we were never wholly successful in its treatment or control is evidenced by the great many amputations rendered necessary from this cause alone. We are not yet sufficiently far removed from the war to view in proper perspective its results from a surgical standpoint, but yet a sufficient time has elapsed to enable us to judge adequately as to the values of most of the surgical procedures adopted. While it is improbable that in civilian practice we will ever see bone sepsis to the same extent as in war, yet in industrial and railway surgery we have to deal with similar conditions, even if not to such an extreme extent.

Our first consideration is the question as to how far the war methods succeeded in overcoming the problems of sepsis, and, in the light of our knowledge of late results, which of the many methods adopted do we find ought to be perpetuated in civilian practice. Concerning the question of how far the bone infection endangered the life of the individual, we cannot offer any criticism, as only those surgeons who have met these extreme conditions in casualty clearing stations and other hospitals down the line can form a just opinion as to this point. It is certain, however, that, owing to stringency of war conditions, many limbs had to be amputated which might have been saved with the opportunities and time permitted for treatment in civilian hospitals.

The extensive *débridement* practiced in the later years of the war undoubtedly resulted in the saving of an infinite number of lives and resulted in early healing of soft parts in a

[1] Presented before the Clinical Congress of American College of Surgeons, Montreal, October 11-15, 1920.

similar number of cases. The value of *débridement* in the soft tissues was early so apparent that many were encouraged to try similar treatment in bone structures, and the result was that in a great many cases, not only were palpably loose pieces of bone removed, but many which had some attachment to periosteum from which they could hope to receive a sufficient blood supply, were removed. In addition some surgeons advocated chiselling away bone surfaces which had been contaminated. This removal of bone practically always resulted in a gap sufficient to prevent subsequent union.

The pathological conditions in soft structures and in bone structures are not analogous, and therefore must be differently handled. From the trauma and infection combined, the soft structures are usually destroyed for some distance beyond the ragged wound itself, as can be determined by the color and the lack of contractility of muscle tissue. These structures become necrotic and make good culture fields; hence their removal is logical. The bone, however, by reason of its structure will not be deeply invaded by infection, and trauma may not widely destroy it, and as no one can tell what fragments will have their circulation restored if left alone, it seems wise, viewing the situation from this distance, to recommend leaving, even in septic fields, fragments which have any attachment from which revascularization may take place. These fragments often form centers of osteogenesis, and may be the factor upon which union depends.

In lesser degrees of infection, and in clean fields, these fragments should always be left. One of the anxieties which faced most surgeons in pre-war days has been largely eliminated, *viz.*, the fear which commonly prevailed that sepsis usually results in non-union. It has been found that not only do septic bone fractures unite in most instances, but when there is non-union it is most frequently due to some other cause.

Mild sepsis is known to be a stimulant to bone granulations, and if apposition of the fragments is secured, even while a portion is being extruded as a sequestrum, union will take place. For this reason care should be taken to secure and maintain proper alignment and length in all septic fractures, with the hope of ultimate union. So important is this factor in treatment, that one is not only justified, but really required, in the interests of the patient, to adjust malpositions, even in the septic stage, before union has taken place. Opening up these cases sufficient to align the fragment, and even holding them in apposition by wire or kangaroo tendon rarely results in a "flare-up" of the infection to do any harm, and numerous cases are available as evidence that this line of treatment is satisfactory and successful. The work done by Major W. E. Gallie, in the Canadian Granville Hospital in Buxton, is most commendable. For the purpose of extension and alignment the greatest credit is due to Sir Robert Jones and his colleagues of the Liverpool school for their success in bringing so generally into use the Thomas splint, and its various modifications, for fractures of the single bones of the extremities. If in civilian surgery the lessons of the war, especially in its later stages, are properly taken to heart, it will result in enormous improvement in results in severe compound, comminuted, and septic fractures of the extremities. If proper use is made of these methods of fixation and extension, much of the reparation or reconstruction surgery, such as osteotomy for malunion, would be eliminated from surgical practice. The transportation of these severe fractures is made so easy for the patient by the Thomas splint properly applied, that every civilian ambulance and first aid center should be supplied with a series of them.

Sequestra and sinuses. As a result of the plugging of vessels from thrombosis in the bone structure, or the cutting off of the blood supply to certain portions of bone by its separation from its periosteal or endosteal supply, necrosis frequently follows, and ultimately the separation of this necrotic area from the balance of the bone. Cloacæ in the bone and sinuses in the soft tissue persist, so long as this fragment remains. It should be recognized that only two conditions can perpetuate a sinus—either a foreign body in its depth, such as a sequestrum, a shell frag-

ment, or bit of infected clothing—or a non-collapsible wall, either bony or fibrous. The treatment of this condition has received a new impetus from the work of war surgeons. The removal of the fibrous wall of a sinus is most easily done by complete excision, and this should be done in exposing the foreign body. Sufficient surrounding bone, which may be healthy, must be removed to expose the sequestrum and permit of its removal. After removal it is sufficient to scrape away the unhealthy granulations forming the bed of the sequestrum, and closure will result. If the bed of the sequestrum is deep, and the wall overhanging so that it will leave a non-collapsible cavity too large to fill in with granulation tissue, the walls will have to be removed to convert the deep cavity into a shallow saucer-shaped one, and permit the soft tissues to fall in and fill the cavity. Care should be taken in this procedure to chisel off periosteum and bone together, and not strip the periosteum back for some distance beyond the saucer edges, as this latter method might result in cutting off the blood supply from a further piece of bone, and necrosis and sequestrum formation might follow. Cavities in bone near the joints, which cannot be treated in this way, yield good results by sloping the sides as much as can be reasonably done, and cleaning out the unhealthy granulations. A generous flap from an adjoining muscle is then switched into the cavity and fastened. Fat or fascia as a filler has not proved satisfactory. It is definitely known that in the healing process infective foci may be surrounded in bone structure and remain latent, to become a source of trouble at a future date if the vitality of the patient is taxed, or to become a source of infection if future operation measures are necessitated for bone graft or other repair.

Periods varying from 6 months to 1 year must elapse before one may feel justified in cutting into this septic bone structure for purposes of repair. A two-stage operation is recommended by many surgeons: first, to remove by excision the soft tissue scar over the area and prepare the site of future graft in the bone, and later to complete the operation by placing the graft.

Bone grafts. Bone grafting has made a place for itself in the reconstruction of bony defects, and the principles underlying its application have been so thoroughly studied and presented that it is not necessary to go into the details as to its use, but it seems wise to emphasize certain points, in order to prevent its misapplication.

In general the inlay graft, as advocated by Albee, has proved the most satisfactory. The intermedullary graft is scarcely ever applicable, owing to the fact that in most cases the medullary canal is destroyed, and again, this type of graft would to a degree endanger the blood supply to the bone ends from the endosteal surface. The homogeneous graft is preferred, not because it is a very active agent in osteogenesis, but from the fact that it is most readily penetrated by osteoblasts, and not so subject to autolysis as foreign bone.

A practical point in the technique which has proved useful may be noted here. The inlay graft, cut with a twin saw, does not fit snugly, and leaves a gap to be filled in with blood. A single saw is now always used, and a diamond-shaped graft cut from the sound tibia. In the case of a single bone like the humerus or femur, a similar-shaped V piece is removed from each bone end, and then the apex of the V is continued up the shaft as a single cut for an inch or more, thus converting the V into a Y. This permits of the diamond graft being driven into one prepared V very snugly, and, by separating the margins with an osteotome, the other end of the diamond is squeezed into the other prepared V. A little practice makes it possible to fit this graft so that no retaining sutures are necessary, and the limb can be lifted without disturbing the graft. In the thin bones of the forearm or fibula, a single saw cut up the center is all that is necessary to receive the diamond graft. This tightly fitting graft is highly satisfactory. Three months' immobilization of the limb is necessary to ensure good union. It would seem almost unnecessary to suggest that in no instance can a steel plate screwed to the bone fragments across a fibrous non-union ever result in union, and yet one still sees cases in which such an operation has been performed. The fibrous tissue must be removed from

between the ends and the sclerosed bone ends cut through until bone is reached which contains living bone cells capable of osteogenesis. The sclerotic bone end containing no bone cells varies in depth, depending upon the length of time the non-union has existed and the degree of trauma inflicted. In the single bones, as the humerus and femur, the ends should be brought together, as bridging a gap will not usually result in a strong useful repair. In such single bone it has been found satisfactory often to make a picket of one end and cut a V piece in the other, bringing the ends together firmly in this way, and fastening them with wire or kangaroo tendon. When a gap occurs in one of the double bones of an extremity, the gap may be successfully bridged by such a graft, and it is not found desirable to shorten the other bone to lessen the gap.

In civilian life, as in army practice, the two great causes, aside from constitutional conditions, of non-union are lack of apposition, and the interposition of some structures between the bone ends, which subsequently is changed into fibrous tissue. The same principles are applicable in the treatment of both conditions.

JOINTS

In the joint conditions of the war, the greatest menace to life and limb was infection, and in the early stages it was responsible for many of the amputations, especially when there was associated massive comminution of the bones forming the joint. This was primarily due to the difficulty of adequately draining the large joints, such as the shoulder, knee, and hip.

Sufficient time has elapsed in a great many of these cases to permit of a study of the end-results of the various methods adopted, and the writer's impression of these is presented. By virtue of the writer's position as orthopedic consultant to the army in Canada since the armistice, opportunity has been presented of seeing most of the cases in all of the hospitals from Halifax to Victoria. In the through-and-through bullet wounds, even when the bones were penetrated, it was a perpetual source of surprise to see so many with very little impairment of function of the joint. In most of these there was no infection, the wound healing in 10 days or 2 weeks. In the widely infected joints treated by drainage and various methods of flushing with disinfectants, ankylosis of the fibrous or bony type usually occurred. If the joints had been placed in good position, the degree of usefulness of the limb was very great, but it unfortunately happened that the greater percentage of these cases was not in the most useful position, and consequently required operative interference, such as osteotomy, to correct this defect. It should be emphasized that much of the reconstruction surgery that one is called on to do is preventable, and the chief value of a paper of this sort will be lost unless this point is made very clear. It is just as easy to place a limb in such a position that the best functional result will be obtained, if ankylosis should occur, as it is to place it in a bad position. In the main the malpositions in fractures also are unnecessary, as are also many of the contractions and fixations of the tendons in their sheaths, etc. The best positions for ankylosis of the various joints, for usefulness in the ordinary normal occupations, are in the writer's estimation as follows:

The *shoulder-joint* in abduction of about 45° from the side of the body, and with the elbow slightly in front of anterior axillary line.

The *elbow-joint*, if single, at angle of flexion of 110°, or slightly straighter than a right angle; if double, one arm, preferably the left, at 120° of flexion, and the other, the right, at 75°, or slightly more acute than a right angle. If pronation and supination are lost, the forearm should be placed in slight pronation, about half way between the mid-position and complete pronation. Many of the cases with loss of pronation and supination can be remedied by a removal of the head of the radius, and a useful range of motion secured.

The *wrist-joint* should be fairly markedly hyperextended, as only in this position can the flexors of the fingers act to advantage.

The *hip-joint* should be in abduction, and slight flexion of about 15°.

The *knee-joint* should be straight in all workers, and only in very exceptional occupations, such as professional callings, should any flexion be permitted.

The *ankle-joint* should be at right angles to the leg, except in some cases in which there is a fairly large degree of shortening of the extremity when a toe drop is permissible.

These statements seem axiomatic, and yet that they are not acted upon is evident, because of the great numbers of operations done solely to improve positions to secure greater usefulness. Osteotomy of the humerus below the head to secure greater abduction, osteotomy of the humerus at the lower end to secure greater or lesser degrees of flexion at the elbow, osteotomy of both bones of the forearm (the radius at its neck and the ulna at its lower end) to correct a faulty position, are frequent operations upon the upper extremity, in our military surgical clinics. It is surprising how many forearms are fixed in complete supination—an almost useless functional position. In the lower extremity the most frequent fault is the adduction flexion deformity at the hip, and an open intertrochanteric osteotomy, with removal of a small wedge with the base outward, is the common method of correction. In practically no case is an arthroplasty recommended in these cases of ankylosis. In the few cases seen which were attempted, a useful joint was never secured.

In civilian life, in certain clean cases of fixation, in selected occupations, an arthroplasty will give a satisfactory functioning joint, but for manual laborers, the results are not so satisfactory as a fixed joint in the position of election.

In the infected joints with marked comminution of bones, the cases which were not primarily amputated were, in the early stages, often widely excised. It is not in a spirit of criticism that attention is called to the fact that most of these cases have resulted in flail, and, for the most part, useless joints. It was thought wise, in all probability, by the surgeon first seeing such a case in front line work, thus to excise widely the joint to secure adequate drainage, and thus save the patient's life.

From the standpoint of end-results, it certainly is wise, when excision is done early, to remove as little bone structure as will accomplish the purpose of efficient drainage, and subsequently to keep up extension for so short a time as possible, in order to allow the excised ends to approximate. In a very small number of the flail joints, the function has been sufficiently good to warrant no surgical interference, the patient being an accountant, or professional man. In the bulk of the cases, arthrodesis has been advocated. This has been difficult to accomplish in the elbow and shoulder. Union has usually been secured in the elbow by dovetailing the forearm bones into the lower end of the humerus and fixing with a bone screw. In the shoulder-joint the best results seen have been by an operative procedure devised by the writer. A flap of the deltoid is turned up to expose the joint freely. The upper end of the humerus is then chiselled off to form a picket shaped end, flattened laterally. The glenoid cavity is modelled with a chisel, removing a flat section of its face, deepest at the upper end, and cutting this off at the upper end by a cut at right angles to its face. This leaves a flattened surface, into which can be fitted the picket end of humerus. The overhanging acromion process is then chiselled away on its lower surface, and a cut from above downward is made with a chisel at the line of the glenoid, about two-thirds through its base. This fragment is then broken down and crowded into position, so that the denuded under surface comes in contact with the outer prepared surface of the humerus. A bone pin is then driven through this displaced acromion, through the humerus, and well into the body of the scapula. This will firmly fix all structures at any angle of abduction desired, depending on the angle of cut in the glenoid.

MUSCLES AND TENDONS

The extensive *débridement* practiced in the later periods of the war in an endeavor to overcome sepsis, resulted in extensive scars and adhesions. The ultimate function of these limbs, when the excision of tissue was from the large and bulky muscle structures of the gluteal region or thigh, and in many cases of the upper arm, has been exceptionally good, and warrants similar practice in these regions, when necessary, in civilian injuries with infection. The amount of function of the remnant

of muscle left after excision of a large portion of its substance, is encouraging, if the nerve supply to this remnant remains intact. In the forearm and leg, where tendons have been extensively exposed, the tying down of these structures by adhesions has resulted in great loss of function. In many cases the baneful effects have been overcome by tendon transference, but in many the function is irreparably lost. Only very grave immediate danger to life will warrant the continuance of such *débridement* in these regions.

It is possible, in the forearm or hand, to separate the adherent tendons as advocated by Kanavel, and by surrounding the tendons by fascia covered with fat a useful hand can be hoped for in some cases, but in the main these results are not brilliant.

Probably no department of the Medical Service has produced more dramatic results than those obtained in restoration of function following tendon transference in irreparable nerve injuries. This subject has been given a great impetus as a result of this work and its further development and employment in the paralytic conditions of civilian practice is inevitable. Preceding the war, most of the work of tendon transference had been done on the lower extremity, as it was felt that the intricate and complex movements of the forearm and hand were not likely to be greatly improved. During the war, however, it has been demonstrated that the upper extremity lends itself most admirably to this type of surgery, especially where the demand has been for movement, without too much strain.

In the lower extremity the transferred muscle has not only to take on the function of movement of the part, controlled by the replaced muscle, but has to stand the strain of weight-bearing as well. The result frequently has been that the strain is too great, and the function imperfect, or lost.

In the upper extremity, where strain can be limited, and movement is the essential factor, the results have been most happy.

The principles upon which this work is based are simple, and yet unless they are understood and adhered to, good results cannot be attained. So far as possible, muscles with a function similar to that they are to undertake, should be used; extensors for extension, flexors for flexion, etc. The line of pull should be as straight as possible, so that the origin of the muscle and its new insertion shall have as direct a pull as possible. The suture of transferred tendons should be made under some tension, and the strain relieved by position. This is essential, as it is not always possible to get a straight pull at first, but this straight line is assured at a later date, and consequently the muscles are relaxed. Also the line of suture usually gives somewhat. The suture material should be a non-absorbable suture, such as linen, as tendon structures unite slowly, and catgut often absorbs before union is strong enough to stand the pull put upon it with use.

If it is necessary to use a muscle the function of which is not the same as the one it is to supply, such as a flexor to take the place of an extensor, the whole muscle must be used. It is not possible to split off part of a flexor and transfer it to an extensor and hope that it will functionate. This would be to expect the muscle belly by its contraction to flex at one time and extend at another the member it controls. When the muscle of an opposing group is used, it must not be expected to function in its new position without a fairly long period of re-education. The active use should be commenced early, at the end of 3 weeks, to secure the best results. The limb for the first 3 weeks should be put in a plaster splint, in a position to relax the sutured tendons.

The most satisfactory of all of the tendon transfer cases is that for wrist and finger drop, as result of an irreparable musculospiral nerve lesion. Here the pronator radii teres is detached from its insertion into the radius, and carried through the wrist extensors—the extensor carpi radialis longior and brevior—and stitched to the tendinous portion of the long wrist extensor, the wrist being hyperextended to make it taut. The flexor carpi radialis is detached from its insertion and carried in a direct line through the subcutaneous fat to its insertion, into the four common extensor tendons at the wrist, including the extensor minimi digiti. The palmaris longus is similarly detached and carried in the

same plane to the extensor surface and attached to the three extensors of the thumb—the extensor ossis metacarpi, the extensor primi, and extensor secundi pollicis. These tendons, transferred after scraping the sheath completely off, are sutured into a split in the tendons to which they are transferred, and double stitched with linen. The hand and forearm is encased in plaster with hand, fingers, and thumb completely extended. At the end of 3 weeks, musle training is commenced, and continued for 2 months. Improved function of an extremity in cases of paralyses where tendon transference is not possible, is secured by a fixation of the paralyzed tendon above the joint, as described by Gallie.

In cases of wrist drop, where flexors or pronators are not available, the wrist extensors may be planted into a groove in the radius and ulna above the wrist-joint, with the hand in the position desired. In 6 or 8 weeks these tendons become firmly fixed, and secure the permanent extension of wrist.

In a similar way in drop foot from paralysis, the peroneus brevis and tibialis anticus may be planted into a groove in the tibia and fibula above the ankle, and will secure the foot in a right-angled position.

NERVE INJURIES

Owing to the fact that thousands of cases of nerve injury have been available, it has been possible to study the problems presented, and to systematize our knowledge of the results. Taken as a whole the results of suture of injured nerves has been disappointing, but there has been a tremendous gain in our knowledge of these conditions and methods of dealing with them. The nerves which are wholly motor or wholly sensory have yielded infinitely better results after treatment than the mixed ones.

Probably the best results secured have been in the musculospiral and sciatic nerves; the poorest in the ulnar. The reason for greater percentage of failures in the mixed nerves has been probably due to our inability to coapt similar areas in the proximal and distal ends so that motor axones will find their way into motor areas and sensory into sensory. The study of Stoeffel into the topography of the peripheral nerves may make it possible in the future to determine the various tracts in both ends of a cut nerve, and let us approximate so that sensory and motor tracts will be in their right relation.

Certain other facts have been brought out which are of interest. The nerves sutured early after injury have done better, and a larger percentage of recoveries have resulted than in the ones sutured long periods after the injury, with subsequent long-continued infection. Primary suture in the presence of infection very rarely results in recovery without second operation for removal of scar tissue from the nerve. This, however, is not an argument against primary suture when the end of the nerve can be readily found at time of early *débridement* or drainage operation. The primary operation has served the purpose of keeping the ends approximated, and they are thus readily found, doing away with the necessity of so extensive an operation to locate widely separated ends. It also keeps the length, and long gaps are not so frequent.

The indications for operation have been so frequently the subject of papers that they will be touched only briefly in passing.

If a muscle response to faradic stimulation is lacking, the galvanic response is noted as to whether it is brisk or sluggish, and the condensor reaction noted, with the number of microfarads at a definite voltage recorded.

Treatment by galvanism, to the point of visible muscle contraction with massage is carried out daily for a period of say one month, and the reactions again noted. If the galvanic response is more prompt and the condensor report lowered, it is wise to continue treatment for a further period. If, however, the reverse is true, than a block is assumed. End-to-end suture has been the only satisfactory method of securing restoration. The fibrous ends are cut back until nerve bundles are seen definitely to pout, and then the union is made by suture of the sheath by interrupted plain catgut No. 0. The suture must be accomplished without undue tension, the nerve being freed for long distances above and below, to secure approximation, and in cases where it is possible the

nerve may be displaced and transferred, to secure a shorter line. The limb should also be placed in most favorable position to secure relaxation.

The line of suture was in early cases covered, various materials such as fascia lata, Cargile membrane, fat, or tube of vein being used for this purpose. These have been given up, and the line of suture is laid in a bed of clear muscle tissue when possible, and the wound closed. In no circumstance has the writer seen recovery where gaps have been bridged either by nerve grafts, by tubulization by veins or fascia, or by connecting the ends by catgut strands.

A few interesting examples of nerve transfer have been noted, such as that reported by Harris, of the transfer of the proximal end of the normal radial to the distal end of the destroyed median just above the wrist. This has resulted in complete restoration of sensation over the anæsthetic median area.

VESICOSIGMOIDAL FISTULÆ[1]

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IN the study of vesicosigmoidal fistulæ, which are of relatively infrequent occurrence, it may be advisable to review the embrylogical development and the relations of the involved organs. Bailey and Miller have said in substance, that the cloaca originates from the dilated caudal end of the allantoic duct, and its cavity is separated from the outer surface of the embryo by the cloacal membrane which is composed of a layer of entoderm and a layer of ectoderm with a thin layer of mesoderm between. The cloaca then becomes separated into two parts, a large ventral part which forms the urogenital sinus, and a smaller dorsal part which forms the rectum. The slightly larger cephalic part of the urogenital sinus becomes the anlage of the urinary bladder, while the smaller caudal part becomes the anlage of the urethra. The sigmoid develops from the caudal end of the primitive gut. "The rectum and sigmoid unite leaving a terminal sigmoid constriction in 80 per cent of the cases" (13).

It has been my privilege to make about 1,000 proctoscopic examinations at the Mayo Clinic, and in approximately 80 per cent of the patients a terminal sigmoid constriction could be demonstrated, that is, there was anatomical obstruction to the passage of the proctoscope. The obstruction, however, may have been influenced in some instances by the mesentery of the sigmoid and the shape of the sacrum. This constriction is a probable cause of diseases of the rectum, such as the accumulation in excess of gases and fæces, of acquired diverticula, of diverticulitis, of localized acute infections, of chronic infections, and of secondary malignancies.

Piersol (17) states that the sigmoid flexure begins at the crest of the ilium as a loop of varying length and shape, and ends at the middle of the third sacral vertebra. Its usual length is from 25 to 56 centimeters. It has a mesenteric attachment and may be free, or it may be bound down closely. As the sigmoid flexure descends along the sacrum it usually curves to the right and crosses the median line. The urinary bladder, ileum, sigmoid, and female pelvic organs are all in close proximity.

Pascal, in his study of the literature of vesicosigmoidal fistulæ up to 1900, found 206 cases. Forty-two were added to this number by Pristavesco and, in 1915, 8 additional cases were added by Cunningham, making a total of 256 reported cases. Seventy-five per cent of the patients in this series were females and 25 per cent were males. Cripps found 17.46 per cent of 63 cases of enterovesical fistula to be vesicosigmoidal. Chavannaz found the frequency of the vesicosigmoidal variety to be 24.07 per cent, and Parham and Hume placed it at 33 per cent. Bryan made an excellent

[1] From the Section on Urology, Mayo Clinic, Rochester Minnesota.

study of 52 vesicosigmoidal cases from the literature, adding thereto one case of his own.

Cripps states: "Research into the subject shows indisputably that enterovesical fistulæ are far more commonly the result of inflammatory mischief than due to perforation from cancerous growth . . . . These records extend over nearly two centuries, from the time when old Anthony Fathergill thought the disease might be cured by a course of Bristol water and ass's milk, to the cases successfully treated by colotomy, published by Mr. Bryant." Cripps found that 3 cases were due to simple ulcer, although often tuberculous origin was suspected. One case apparently was due to an ulceration from an abscess originating in a diverticulum of the bladder.

ETIOLOGY

Either directly or indirectly, diverticulitis of the sigmoid (11) may be a factor in the production of vesico-enterosigmoidal fistulæ (3, 7, 20). Diverticula may be congenital as in the Meckel type, or they may be acquired. In 1907, Wilson introduced and applied the term "diverticulitis" (13) to cases in which acute inflammation of the mucosa occurred within the diverticula; and "peridiverticulitis" to cases in which chronic inflammations of the subserosa occurred around the diverticula(14). In 1908, Telling, in his excellent contribution on acquired diverticulitis, mentioned etiological factors as follows:

1. Age varying from 55 to 67 (80 patients);
2. Fifty-five of 81 patients males, and 28 females;
3. Previous or present obesity of the patient;
4. Cachexia and absence of obesity, in many instances following previous obesity;
5. Local structural yielding of the walls of the large intestine;
6. Abnormally long retention of fæcal material in the sigmoid, producing increased internal pressure;
7. Pressure from within the bowel: (a) constipation, and (b) flatulence;
8. Relation of diverticula to points of entry of vessels through the gut walls;
9. Variation in the size of the vessels, as in venous congestion and subsequent reduction;
10. Congenital predisposition with regard to the amount and laxity of connective tissue surrounding the vessels at these points;
11. Muscular deficiency of the gut walls.

Telling illustrates the pathological changes that may occur in the diverticula as follows:

1. Infection of the general peritoneal cavity from thinning of the sac walls without perforation;
2. Acute or gangrenous inflammation (diverticulitis);
3. Chronic proliferative inflammation with thickening of the gut wall and stenosis of the bowel;
4. The formation of adhesions, especially to the small intestine and bladder;
5. Perforation of the diverticulum, giving rise to (a) general peritonitis, (b) local abscess, (c) submucous fistulæ of the gut wall, and (d) fistulous communication with other viscera, especially the bladder;
6. The lodgment of foreign bodies;
7. Chronic mesenteritis of the sigmoidal loop;
8. Local chronic peritonitis;
9. Metastatic suppuration;
10. The development of carcinoma (10);
11. Perforation into the hernial sac.

In 1912 McGrath mentioned among "pathologic processes," observed by various authors, "which resulted from infection through intestinal diverticula: acute or gangrenous inflammation of sigmoid diverticula with symptoms so closely simulating appendicitis as to suggest a transposition of the viscera. Perforation followed by localized abscess or general peritonitis has resulted from this process. . . Perforation resulting in general peritonitis, local abscess formation, submucous fistulæ, and fistulous communications with other structures. Sudden perforation with resultant general peritonitis has followed straining at stool. Abscesses have formed in the intestinal wall, outside the wall, and surrounded by coils of small intestine, in the mesentery and extending to the liver and left kidney. Abscess formations have simulated carcinoma. Fistulous tracts have resulted between the sigmoid and the small intestine, the abdominal wall, and, most frequently, the bladder. Sudden perforation into the bladder has occurred on lifting a heavy weight. In some cases the fistulous communication was direct between a diverticulum and viscus, but in others it occurred by way of an interposed abscess cavity."

Although diverticulitis is found more often in adults, and especially in the aged, occasionally it is found in children. Ashhurst reported

TABLE I.—MODIFIED CLASSIFICATION OF ETIOLOGICAL FACTORS IN VESICOSIGMOIDAL FISTULA ACCORDING TO PASCAL, BRYAN, AND CRIPPS

A. Traumatic:
  1. Accidental
    a. Gunshot or shell splinter
    b. Surgical
    c. Injury; labor or perforation of the bowel by foreign body from within or from without
  2. Intentional
    a. Self-inflicted wounds by the insane
B. Nontraumatic:
  1. Inflammatory
    a. Abscess: tuberculous; amœbic; gonorrhœic; actinomycotic; typhoidal; bacillus coli
    b. Stricture: syphilitic; secondary to inflammatory ulcer within the gut; secondary to inflammatory process without the gut but adjacent to or surrounding it
    c. Stone
    d. Ulcer: simple; tuberculous; amœbic; syphilitic; typhoidal; actinomycotic; ulcerative colitis
    e. Diverticulitis: sigmoid; bladder
  2. Tumors
    a. Benign
    b. Malignant
    } extrinsic or intrinsic
  3. Congenital anomalies

one case of a child aged 5, and Walcha reported one of a child aged 10.

A modified arrangement of Pascal's, Bryan's, and Cripps's classification of etiological factors in vesicosigmoidal fistulæ is given in Table I.

REVIEW OF THIRTY-FOUR CASES

A review of the 34 cases of vesicosigmoidal fistula (Table II) in which operation was performed demonstrates a great preponderance of the type due to inflammation and infection in contradistinction to the fistulæ due to malignant conditions (Table III), the ratio being 14.50 : 1, and to those of traumatic origin, the ratio being 9.66 : 1.

In our series of cases the etiological infection was in organs adjacent to the bladder, such as the appendix, the sigmoid, the rectum, and, most often, the fallopian tubes (38.23 per cent). It may be assumed that an infective process could begin in a diverticulum of the bladder, or in diverticulum with stone, causing a peridiverticulitis and ultimate erosion into the sigmoid. Cases have been reported of advanced malignant disease of the bowel that extended from the bladder into the adnexa by direct extension and infiltration.

TABLE II.—TYPES OF FIFTY-NINE VESICO-ENTERIC FISTULÆ OPERATED ON AT MAYO CLINIC (JANUARY 1, 1907, TO JANUARY 1, 1920)

	Cases	Per Cent
Vesico-enterovaginal	1	1.69
Vesico-enterorectal	1	1.69
Vesico-appendiceal	3	5.08
Vesico-ureterorectal	3	5.08
Vesicorectal	3	5.08
Vesico-ileal	13	22.03
Vesicocæcal	1	1.69
Vesicosigmoidal	34	57.62
Single vesicosigmoidal	21	61.76
Multiple vesicosigmoidal	5	14.70
Complicated vesicosigmoidal	8	23.52
Vesico-ileosigmoidal	4	11.76
Vesico-ileocæcalsigmoidal	2	5.88
Vesicorectalsigmoidal	2	5.88

Diverticulitis of the sigmoid is considered by some observers the most predominant cause of vesicosigmoidal fistula. It is possible that because of the interest taken in the subject this type of case is reported, and others are neglected. Twenty-two (52.38 per cent) of the 42 cases from the literature reported by Bryan were due to diverticulitis of the sigmoid. In the cases from the Mayo Clinic, only 6 (17.64 per cent) of 34 were due to diverticulitis of the sigmoid. The ages of the 6 patients were 27, 43, 49, 54, 56, and 61. Three other patients not regarded favorably for operation had vesico-enteric fistulæ and gave histories simulating sigmoidal diverticulitis, yet the true etiology remained obscure. In Case A 186203 of this series is seen a marked instance of recurrent diverticulum. A diverticulum of the sigmoid had produced a vesicosigmoidal fistula and recurrence of the symptoms ensued 9 months later. At the second operation it was found that a new acquired diverticulum had formed in which a diverticulitis later developed and became the cause of a second vesicosigmoidal fistula. The sigmoid was removed by a Mikulicz resection, making the re-formation of diverticula im-

TABLE III.—ETIOLOGICAL FACTORS IN THIRTY-FOUR CASES OF VESICOSIGMOIDAL FISTULA (MAYO CLINIC)

	Cases	Per Cent
A. Traumatic	3	8.82
1. Accidental		
a. Gunshot (A54223)		
b. Surgical		
Colon nicked (elsewhere) (A148184)	3	8.82
Perforation of uterus and small intestine from dilatation and curettage (elsewhere) (A79288)		
B. Nontraumatic	31	91.17
1. Inflammatory		
a. Abscess		
Left ovarian, surgical accident (elsewhere) (A24056)		
Right ovarian (A47407)	3	8.82
Bilateral ovarian and perforated appendix (A89618)		
Salpingitis		
Bilateral (A48609)		
Bilateral (A25406)		
Bilateral (A4553)		
Bilateral (A245457)		
Bilateral (A291181)	9	26.47
Right (A8463)		
Left with foreign body (A9513)		
Left (A15387)		
Dermoid cyst right broad ligament (A15509)		
Tuberculous salpingitis		
Bilateral (A273740)		
Bilateral (A233622)	3	8.82
Tuberculous left tube and ovary (A156564)		
Tuberculous peritonitis		
Tuberculous peritonitis (A273740)		
Tuberculous postoperative fæcal fistula (A76615)	3	8.82
Tuberculous and suppurative appendix (A75616)		
Appendiceal		
Perforated appendix with abscess (A44697)		
Perforated appendix and general peritonitis (A75616)	3	8.82
Gangrenous appendix and general peritonitis (A113006)		
Postoperative		
Abscess of left ovarian region (A140514)	2	5.88
Abscess with fæcal fistula (A104374)		
b. Diverticulitis		
Sigmoid (A52670)		
Sigmoid (A186203)		
Sigmoid (A291938)		
Sigmoid (A291863)	6	17.64
Sigmoid (A252703)		
Sigmoid (A287296)		
2. Tumors	2	5.88
Malignant		
Carcinoma of the rectum, posterior resection (A7873)	2	5.88
Carcinoma of the sigmoid (A262867)		
Females	26	76.47
Males	8	23.52

possible, and thus eliminating the chance of development of a fistula from such a source.

Diverticulitis of the sigmoid is accompanied by pain and colic, usually in the left lower quadrant of the abdomen, and may give symptoms and signs similar to those in periodic attacks of appendicitis. Many investigators have discovered a secondary carcinoma arising on an old diverticulum which in turn has produced a vesicosigmoidal fistula. The signs and symptoms of such fistulæ due to a primary carcinoma of the sigmoid are of relatively short duration, and they are quite easily distinguished from the recurrent signs and symptoms of diverticulitis with the ultimate increase in severity and activity of a superimposed carcinoma (11). Elsewhere I had opportunity to see a case of vesicosigmoidal

TABLE IV.—CYSTOSCOPIC FINDINGS* IN TWENTY-SIX CASES

Case	Condition of mucosa of bladder			Location and size of fistula	Ureters		Remarks
	Normal	Inflammation			Right	Left	
		Localized	Diffuse				
148184	+			Posterior dome	Normal. Not catheterized. Urine clear	Same as right	
79288		At base, 2		Large irregular tear; right posterior wall above floor			
24057			Marked	Slit 1.3 cm. in left posterior roof	Normal. Clear urine	Urine absent for 10 minutes	Impassable stricture left ureter 9 cm. from meatus
47407		Granular tissue around fistula	Slight	Opening in roof of bladder 4 cm. in diameter	Normal	Same as right	Odor of hydrogen sulphide in catheterized urine
48609	+	Small area around fistula		Small pin point opening 3 cm. directly back of left meatus	Normal	Normal	
215457			Acute and chronic, 4	Marked cystitis probably due to bladder stone obscuring location	Not seen; not catheterized	Same as right	One bladder stone, 3. (Nucleus – mushroom tip of retention catheter)
291181		Right and left base and posterior wall, 1			Normal; not catheterized	Same as right	
16609		Surrounding mucosa eroded	Slightly	Half way up posterior wall of bladder	Could not be found	Eroded; not catheterized. Function normal	Ten years' duration
194078		Granulation at base, 3	Acute and chronic, 3	Left trigone	Not observed; not catheterized	Same as right	
233622		Ulcerations at left base, 4	1	Left base	Not observed; not catheterized	Same as right	Cystogram showed outline of rectum and lower sigmoid. Bladder represented by a small irregular area. Catheter passed into fistula
150564		Granulation and bullous œdema of left wall and dome		Left roof and posterior wall	Normal. Not catheterized. Clear urine	Same as right	
273740		4		Posterior wall. Ribbon of thick pus oozing from area 4 cm in diameter	Normal. Not catheterized	Same as right	Abscess draining from posterior wall into bladder
68395			1	Above and to the outer side of the left meatus	Gaping; contraction, length, function normal. Clear urine	Normal. Clear urine	Bladder appears to be held by adhesions to other organs
44697	+			Posterior wall just above base	Normal	Appearance and urine normal. Obstruction 18 cm. up	
75616			2	Right posterior wall	Gaping; contraction, length, and function normal. Clear urine	Same as right	Fistula discharging mucoid substance
140514		Chronic, 2; posterior wall and posterior dome about fistula, 1; trigone 1. Rest of bladder clear		Posterior upper wall	Normal. Urine clear. Not catheterized	Same as right	Definite opening not found, either visually or with a pointed 4 catheter. Stellate scar observed
113006	+	Posterior wall about the fistula, 3		Posterior wall and covered by a fold of the bladder	Normal. Clear urine	Same as right	
104374		Few areas, 2. Ulceration on posterior dome and granulations	Posterior wall and dome, 3	Posterior dome	Normal. Urine, pus 3, red blood cells, 3	Normal. Pus 3	Diagnosis: vesico-enteric fistula with moderate ascending bilateral pyelonephritis.

* Graded on a scale of 1, 2, 3, 4.

TABLE IV. CYSTOSCOPIC FINDINGS IN TWENTY-SIX CASES (*continued*)

Case	Condition of mucosa of bladder			Location and size of fistula	Ureters		Remarks
	Normal	Inflammation			Right	Left	
		Localized	Diffuse				
186203		2-21-17; areas 2, trigone 2. 7-29-18; left wall and base, 3		2-21-17; left wall and base back of trigone. 7-29-18; left wall and base back of trigone	2-21-17; normal, not catheterized. 2-21-18; normal, not catheterized. Clear urine	Same as right	
52670		Granular, necrotic	Moderate	Roof left side of bladder	Normal contractions	Same as right	Roof not rigid nor bound down as in malignancy
291038		Posterior left wall and dome, 2		Funnel-shaped depression in left dome surrounded by granulation tissue	Normal	Normal	Negative ray with leaded catheter in left ureter
291863			4, especially base and right wall	Posterior to right meatus and partially involving it	Normal. Clear urine. Pus 1, red blood cells 1. Phenolsulphonephthalein 6 per cent in fifteen minutes	Normal. Clear urine. No pus. Red blood cells 1. Phenolsulphonephthalein 6.5 per cent in fifteen minutes	
252703			1	Eroded depressed area in dome; fistulous opening	Normal; not catheterized	Same as right	Cystogram normal. Prostatic obstruction, fullness, and bilateral intravesical enlargement 2. Overlapping 1. Residual urine one ounce
287296			Acute, 4	Not seen. Granulations covered entire base	Not seen	Not seen	Much pus in bladder
7873			Marked	Vesico-enteric fistula. Location not stated	Not seen	Not seen	Two large bladder stones, 1; possibly recurrence of cancer, 2
262867		Area of necrotic granulations with carcinomatous appearance	4				Fæcal odor of urine

fistula due to a primary carcinoma of the sigmoid, later demonstrated at necropsy. The onset was sudden and the history of short duration. Some cases of vesicosigmoidal fistula due to a primary carcinoma may run a severe and brief course, and because of the general syndrome the patients may not have presented themselves at a surgical clinic. Possibly because of this, my statistics on carcinomatous etiology may not be complete.

Vesico-enteric fistulæ due to infective or inflammatory agents are usually secondary to abscess formation or reduced resistance of the tissues, which are devoid of drainage or have inadequate drainage, and following the laws of gravity or the lines of least resistance they point through and rupture into the urinary bladder. Fistulæ due to trauma are dependent both on the seriousness of the wound and secondary infection (Tables I and III).

CYSTOSCOPIC EXAMINATION

The cystoscopic examinations (4) of 26 of the 34 patients (Table IV) showed a fistulous opening in the posterior wall and dome of the bladder, in 7 (26.92 per cent) in the posterior wall and in the dome in 8 cases (30.76 per cent). The fistulæ were definitely to the left in 9 cases and to the right in 3; the incidence was influenced largely by the close proximity of the left bladder wall and sigmoid, although the primary focus may have arisen from other adjacent organs. In 5 cases the fistulous opening was in relatively close proximity to the left ureteral meatus and in 1 it partially involved the right meatus. If granulations are abundant about the fistula and the meatus, and a spurt of urine does not distinguish the openings, as in Case A 233622, the catheter may be passed either into the fistula or the ureter, which would be shown only in the roentgenograms.

Diffuse inflammatory changes occurred in 15 patients; in 5 it was but slight, in 3 moderate, and in 7 marked. In 13 cases there were areas of inflammation surrounding the fistulous opening ranging from simple hyperæmia to exuberant granulations, bullous œdema, ulcerations, necroses, and erosions. Outside of these areas the bladder mucosa was normal in 8 cases (30.76 per cent); and it was found to be entirely normal in 2 (7.69 per cent). A probable cause for the usual freedom from a diffuse cystitis is that distinct lymph channels are absent within the mucous membrane (18); that the mucosa is made up of transitional cells of the expansile, protective, and non-absorbable type, and that the amount of infective material is being diluted and kept more or less in motion by the ingress and expulsion of the urine, and by muscular activities.

The duration of the bladder symptoms in the 34 cases was given by 28 of the patients approximately as follows: Two were free from symptoms; one had symptoms for 1½ months; one for 2 months; one for 3 months; 2 for 4 months; 4 for 6 months; 3 for 7 months; 6 for 1 year; 2 for 1 year and 6 months; 1 for 2 years; 3 for 3 years; and 2 for 10 years prior to examination. Twelve therefore had symptoms for less than 1 year; 14 for 1 year or more and 2 for more than 3 years; in the latter the symptoms of very mild diffuse cystitis (1 on a scale of 4) with erosion or ulceration about the fistulous opening extended over a period of 10 years. The average duration of symptoms of patients with a marked cystitis was nearly 1 year.

The inflammatory changes were largely due to (1) the size of the fistulous opening, (2) the amount and character of the bowel contents and foreign bodies passing into the bladder, (3) urethral obstruction, as in stricture or hypertrophied prostate, and the amount of residual urine, and (4) the type of infective organisms. Besides other types of urethral obstruction, the urethra may become clogged by a fæcal mass, or other foreign body, which not only causes paroxysms of pain but may help to distend the bladder, especially if the fistulous opening is valve-like. In this manner infective agents may be induced into the ureteral openings and cause an ascending ureteropyelonephritis, either by direct extension or implantation. This, however, rarely occurs. In this series there was but one such case. Obstruction was encountered in two catheterized ureters, one of which was seemingly functionless; in two of these cases cystitis was marked. Three meatus were gaping but the urine from all was clear. If the contents of the bladder are obviously infected by ureteral catheterization, a pyelitis may arise in a kidney that otherwise would remain healthy. Seventeen ureters were catheterized and pus was found in only three. Secretion was absent in one.

Care must be used in searching the suspicious inflammatory area for the fistulous opening with a small pointed catheter, for the tissue is often œdematous and friable. I have passed a pointed No. 4 catheter into the tissue, but not far enough to do damage, with as much ease as though it were passing into a small fistula. The danger lies in making new fistulous communications in the surrounding inflammatory tissue with the possibility of passing the catheter into the peritoneal cavity, and carrying infective organisms with it. In cystoscoping one patient (Case A 140514) I could easily see a stellate scar on the posterior upper wall of the bladder, but after a reasonable amount of effort to demonstrate the opening (because of the positive history of berry seeds and gas having passed through the bladder), the attempt was abandoned. During the operation Dr. Judd traced a fistulous tract from the sigmoid to the region of this scar but no opening could be found, thus demonstrating that vesico-enteric fistulæ of infective and inflammatory origin at times heal spontaneously. The postoperative results in our series demonstrate that many of the recurrent fistulæ slowly and gradually diminish in size and may ultimately heal.

Vesicosigmoidal fistulæ may also be shown by the cystogram and the use of sodium bromide. Methylene blue injected into the bladder will pass through the rectum; also if this solution is injected into the rectum it will pass in the bladder contents. This type of fistula will be demonstrated by proctoscopic examination but with greater difficulty than with the cystogram. By the proctoscope an

TABLE V.—POSTOPERATIVE RESULTS IN THIRTY-FOUR CASES OF VESICOSIGMOIDAL FISTULA

Case	Cure	Improvement	Recurrence	Remarks	Death
54223	+				
148184	+			Intermittent fæcal fistula for 1 year and 3 months	
79288	+		After 3 weeks	Four months after operation fistula remained; condition of bladder much improved; only pus in urine. Fistula healed in 3 years and 3 months	
24056	+			Slight bile colored drainage from wound gradually diminishing	
47407		+	+	Temporary closure for 8 weeks 4 months after operation. Persistent sinus in abdomen and cervix	
89618	+			Wound nearly stopped draining in 8 months	
48609		+		Gas continued. Cure was temporary	
25460	+				
4553	+				
245457	+			Gradually healing fistula	
291181	+				
8463				Patient not heard from	
9513				Patient not heard from	
15387	+			Slight purulent drainage from wound on dismissal	
16609					After 5 days
194078	+				
233622	+			Slight seropurulent drainage from wound on dismissal	
156564	+			Only slight purulent discharge from wound on the twenty-eighth day	
273740	+			Purulent vaginal discharge. Also purulent discharge from abdominal sinus through which flatus had passed but no fæcal material	
76615	+				
68395	+			Fæcal fistula closed at operation 8 months later	
44697	+			Very slight drainage of wound on fifteenth day	
75616		+		Cure was only temporary and recurrence intermittent	After second operation from localized peritonitis.
113006	+			Fæcal fistula gradually improved	
140514	+				
104374				Small fæcal fistula one year later; little gas from bladder. Bladder irritability greatly lessened. Urinalysis negative	
52670	+				
186203	+		Nine months after first operation	First operation 2-28-17; second operation, removal of sigmoid, 10-26-18; cure	
291938	+			Gradually healing fæcal fistula. Slight seropurulent drainage from wound on dismissal	
291863					Five days after second operation from peritonitis
252703					Two days after second operation from peritonitis
287296		+	+	Condition improved subsequent to second operation, 12-3-19	From influenza, 1-20-20
7873	+				Four months later
262867				Case inoperable; permanent colostomy as palliative treatment	

inflammatory area, an inflammatory or benign stricture, or tumor in the presence of malignancy is more often observed. The odor of hydrogen sulphide of one specimen of catheterized urine may have arisen from gases produced in the intestines or from the transformation of contents in the bladder, but foreign to it. A bladder stone may form by the incrustation of lime about a foreign body, either from the fistula or from the urethra, such as the retained tip of a urethral catheter, and not only help to produce an acute and chronic diffuse cystitis, but lessen the possibilities of the fistula becoming more diminutive, thus augmenting the patient's discomfort.

In cases of extrophy of the bladder, or carcinoma of the bladder, the ureters may be successfully transplanted into the sigmoid and the patient apparently suffers no ill effects from urinary absorption, or from ascending ureteropyelonephritis. There may be a valvular action of a vesico-enteric fistula to keep any great amount of urine from entering the bowel. Negative urine in the small or large intestine apparently does not produce any untoward results, but decomposed urine, absorbed by intestinal mucous surfaces, may be a large factor in contributing to a fatal result.

In 11 of 21 urinalyses albumin, red blood cells, and pus averaged 1 on a scale of 4. Pus 3 to 4 was found in 8 instances. Hyaline casts were found once. The average specific gravity was 1,017. The urine was alkaline in these cases. Fæcal matter was discovered in three.

The diagnostic features of vesico-enteric fistulæ are bladder irritability, frequency, and dysuria, the elimination of gas, the final appearance of fæces or foreign substances in the urine, and the demonstration of the fistula. The presence of gas alone is not corroborative evidence unless it extends over a long period of time, since it may have been introduced by intravesical treatment or by instrumental examination.

The prognosis as to life depends principally on malignant or nonmalignant factors, peritonitis, metastatic foci of infection, and embolism, while prognosis as to cure depends on the nature, location, and extent of the infective process, and response shown by patient to proper medical and surgical treatment.

The patients' ages varied from the third to the seventh decades; 7 patients were between 20 and 30, 13 between 30 and 40, 8 between 40 and 50, 4 between 50 and 60, and 2 between 60 and 70.

OPERATIVE RESULTS

Twenty-three of the 34 patients (67.64 per cent) were cured by operation, the condition of 6 was improved, 6 had recurrences, and 2 of these had definite recurrences of symptoms as severe as they were originally. One of these patients was cured at the second operation, and the other improved but died of influenza. There were 4 postoperative deaths, a mortality of 11.76 per cent. In 11 cases (32.35 per cent) the vesical fistula was cured but a fæcal fistula remained. In 5 the drainage gradually stopped in from 15 days to 3 years and 3 months; in 1, cure was effected by a second operation; and in 2, the fistula gradually healed, no time limit being given (Table V).

After free drainage has been established, a proper radical dissection with the removal, in so far as is advisable, of all diseased tissue has been done; if the approximation is made with difficulty the sigmoid is closed over a large rectal tube. The results are gratifying even though there may be a gradually diminishing fæcal fistula for a relatively short time. Anything that can be done to improve the condition of these patients is worth while for they quite universally consider themselves of all beings the most miserable. They not only suffer from the nasty inconvenience of the fistula itself, but are greatly disturbed mentally over the new modes of eliminating dejecta.

All the patients with vesicosigmoidal fistulæ of tuberculous origin were cured; however, one of them had a mildly persistent abdominal and vaginal suppurating sinus. The greatest difficulty in the technique of these operations is the production of free drainage and the prevention of the establishment or re-establishment of a pus pocket in the operative field which is always considered infected. It is also difficult to prevent the reformation of adhesions between the bladder and the sigmoid whose tissues already have a lowered resistance, and are, together with the probable surrounding infection, conducive to a recurrence of the fistula (Table V).

CONCLUSIONS

1. Bladder mucosa may be normal in the presence of a vesicosigmoidal fistula.

2. Vesicosigmoidal fistulæ are far more commonly the result of infective or inflammatory causes than the result of malignancy; probably the most frequent cause is inflammatory disease of the uterine adnexa and next in frequency is sigmoidal diverticulitis.

3. Stricture or stenosis of the rectum or the sigmoid below the fistulous opening tends to increase the size of the fistula; it may also be one of the factors in the development of acquired diverticula of the sigmoid.

4. Mild cystitis or local areas of cystitis around a fistulous opening with intervening normal bladder mucosa are common symptoms.

5. The symptoms from vesicosigmoidal fistula existed in the majority of the 34 patients for nearly 1 year or more prior to operation. Two had symptoms for 10 years with only mild diffuse cystitis, while those with marked cystitis had had symptoms for about 1 year.

6. Ascending ureteropyelonephritis is not usually associated with vesicosigmoidal fistula.

7. Vesicosigmoidal fistulæ may heal spontaneously, if of infective or inflammatory origin.

8. Subsequent to an operation for vesicosigmoidal fistula due to a diverticulitis of the sigmoid, a new acquired diverticulum may form in which a diverticulitis may develop and produce a second vesicosigmoidal fistula. Such a predisposition to the development of acquired diverticula and their ultimate results may be overcome by a resection of the sigmoid of the Mikulicz type in which tissue of suspicious cancerous appearance is also removed.

9. A large rectal tube is a very useful aid in the closure of the sigmoid; it should be passed up beyond the closure and thus relieve an unnecessary strain that might be exerted upon the anastomosis.

10. Operative results show cure in 67.64 per cent of the patients and improvement in 17.64 per cent more. Contrary to the opinion frequently expressed, the operative results in the presence of local tuberculous infection were good.

11. In 32.35 per cent of the cases cured of vesical fistula a fæcal fistula remained which gradually healed within 15 days to 3 years and 3 months, and in only 2 of these cases was there a frank recurrence of all the symptoms which were cured or improved at the second operation.

12. The operative mortality is low (11.76 per cent).

13. Any reasonable attempt to improve the condition of these patients is advisable.

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ACIDOSIS IN OPERATIVE SURGERY

A Study of Its Occurrence During Operation and Its Treatment by Glucose and Gum Acacia Given Intravenously[1]

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IT has long been known to physiologists that there is an alteration of the chemical composition of the blood during states of activity, emotion, starvation, etc. The importance of this alteration has been recognized for several decades in internal medicine, but it is only recently that this factor has been given due consideration in surgery, for in surgery the interest was centered chiefly upon examination of the tissues removed. Pathology is in its rightful place, but physiology has lagged behind. It is of the greatest scientific value that all pathological specimens be carefully examined and studied, but it is equally as important that the living patient be as carefully examined and studied before and during the operation as the dead specimen is afterward. For this purpose the surgeon must call upon the biological laboratory. It is not sufficient to have a knowledge of physics and chemistry; one must have a knowledge of physical and chemical action in the living organism, and it is necessary that one should have a biological conception of the general metabolism of the body in health to find the cause and remedy when disorganized.

The physiologist and internist at times approach one another but rarely do the surgeon and physiologist come in contact; and yet how much greater is the need for collaboration between the surgeon and the physiologist, as the time may be all too short for the study of a condition suddenly confronting the surgeon at or immediately following an operation.

During the war the government of this country and of others, notably of Great Britain, called upon the physiologists to investigate and find, if possible, remedies for certain surgical problems. A committee was appointed by Great Britain as a "Special Investigation Committee on Surgical Shock and Allied Conditions." With such a step forward in making the laboratory and the operating room more intimately associated, it would seem that biological chemistry had come into its proper field, if the methods of examination could be shown to be simple, adequate, and of practical value.

The development of the theory of acidosis has been a gradual one and chiefly applied to diabetes or nephritis, but its importance in estimating a surgical risk, or its possible value during operation as an indicator of pending shock is only a recent growth, and it is with the object of ascertaining its value under such conditions that the present study has been made.

The word acidosis was first used by Naunyn to designate a condition in which certain acetone bodies were excreted in the urine of diabetic patients, but the term has gradually acquired a broader significance until as defined by Sellard, the essential feature in our conception of acidosis is a general impoverishment of the body in bases, or in substitutes which generally give rise to bases, so that the body as a whole shows some systemic abnormality.

The chemical composition of the blood in health is maintained at nearly constant level by the general metabolism of the body:

A. Energy is produced by:

1. Carbohydrates which are base forming foods;

2. Fats, which are base forming foods, but which need carbohydrates for their complete oxidation, otherwise they break down into oxybutyric or beta oxybutyric acid;

3. Proteids which are the acid forming foods of the body.

B. Elimination is accomplished by:

1. Kidney tubules excreting mineral acids, urea, nitrogen;

[1] Read by invitation before the American Gynecological Society May 25, 1920, Chicago, and before the Clinical Congress of the American College of Surgeons, October 12, 1920, at Montreal.

2. Lungs, giving off carbon-dioxide and water vapor;
3. Sweat glands;
4. Intestinal tract.

If metabolism is faulty then there may be an accumulation of acid by-products in the body due either to excessive production or to defective elimination, or both together, and the condition of acidosis results.

If we stop for a moment to consider the regulation of respiration in health, the importance of this condition will become evident.

The work in 1905 of Haldane and Priestley on "The Regulation of Lung Ventilation" marked an epoch in our knowledge of the factors controlling respiration and has led to the so-called "New Physiology," and has aroused interest in the study of the chemical constituents of the blood. These investigators found that lung ventilation is due to the response of the respiratory center to changes in carbon dioxide tension of alveolar air and arterial blood, and not to stimulation of the vagi nerves. For each individual at rest, and under normal atmospheric conditions, the normal alveolar carbon dioxide pressure appears to be an extraordinarily sharply defined physiological constant, but a slight rise or fall in the alveolar carbon dioxide pressure causes a great increase or diminution in the lung ventilation. As carbon dioxide in watery solution acts as a weak acid, by virtue of the hydrogen-ion, and dissociates into

$$CO_2+H_2O \rightleftarrows H_2CO_3 \rightleftarrows H+HCO_3$$
$$\updownarrow$$
$$H+CO_3$$

it has been thought that the hydrogen-ion of the blood which is practically constant (while the carbon dioxide fluctuates), is the respiratory factor, but later investigators have come to the conclusion that the carbon dioxide in the blood has an influence not due to hydrogen-ions but due possibly to a specific effect of the undissociated carbon dioxide, either directly stimulating the respiratory center itself, or in increasing its irritability to the hydrogen-ions.

The hæmoglobin of the blood carries oxygen from the lungs to the tissue cells of the body, and it is from within these tissue cells that carbon dioxide is produced, the exchange of these two gases constituting the internal cellular respiration.

The tension of arterial blood leaving the lungs is 40 millimeters mercury and in the alveoli of the lungs is 80 millimeters mercury. It is because of the low tension in the arterial blood and the higher partial pressure of carbon dioxide in and around the capillaries that gas is taken up by the bicarbonates in the blood to be given off in the alveoli of the lungs. The bicarbonates of the blood, the so-called "buffer substances" of the blood are then the carriers of the acid by-products of metabolism to the alveoli of the lungs and constitute the alkali reserve of the body. If the bicarbonates are present in the blood in large amount the combining power of the blood, that is the ability of the bicarbonates to unite with carbon dioxide, is high; hence the carbon dioxide tension in the blood is low, but if there is a diminution of the bicarbonates the carbon dioxide will accumulate in the tissues and the increased carbon dioxide tension in the blood will stimulate the respiratory center to increase respiration. If alveolar ventilation is not then obtained a condition of intracellular acidosis results with serious disturbance to internal respiration.

We may liken lung ventilation to an omnibus line with limited seating capacity. If the busses are full the crowds in the streets stimulate the starters to telephone the central office to increase the number and speed of the busses. If all available omnibuses are in circulation and the crowds still increasing, the people must find other ways to return home or the congestion will block the road and overflow into the side streets.

Blood bicarbonate is then the criterion of the acid base balance of the body and its percentage in the blood is a most important factor in surgery. During operation, owing to the increase in acid metabolism and also to the fact that anæsthesia affects the liver which is the regulator of acid by-products, there is a considerable drop in the alkali reserve, but as long as there are fixed bases in the blood the elimination of carbon dioxide

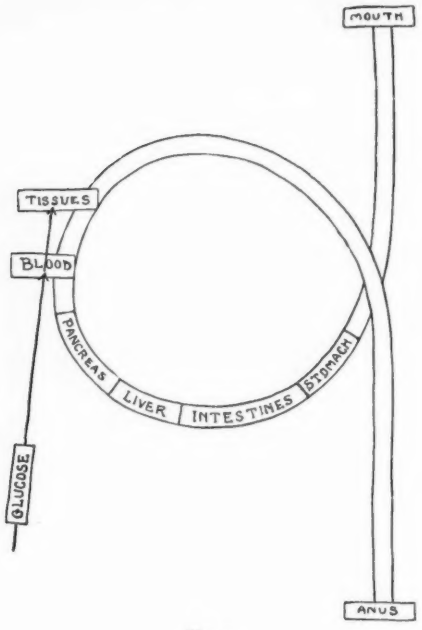

Fig. 1.

will continue. If the alkali reserve is high to begin with the drop may not be great enough to cause a severe acidosis. But the "more marked the existent acidosis to begin with the more sensitive is the patient to operative procedures and the more likely is he to be let down by them into a region of danger."

Lusk proved experimentally that an individual can go without food for a number of days without producing an acidosis, as nature has time to regulate metabolism by drawing upon the stored bases in the body. But in hæmorrhage and shock, in the presence of a lowered blood volume with either actual loss of blood from the body or with stagnation of blood in the capillaries, the fall in alkali reserve in a very short period of time may be so great that the tissues cannot adjust themselves to the altered metabolism and so fail to maintain respiration.

The question arises as to where the loss in bicarbonates occurs. Several ways are possible; such as (1) in excessive pulmonary ventilation; (2) in acetone bodies in the urine; (3) in organic acids other than acetone bodies; (4) in the tissue cells of the body.

Henderson and Haggard believe that the loss occurs in excessive pulmonary ventilation during anæsthesia and that this loss can be prevented by administering 7 per cent carbon dioxide air. Reimann and Bloom, however, have shown that blood acetone bodies account for from 20 to 100 per cent of the lost bicarbonates (on an average 60 per cent), and it is possible that organic acids other than acetone bodies account for an additional amount. Caldwell and Cleveland of the Presbyterian Hospital found acetone present in the urine in 72 per cent of cases following operation and diacetic acid in 56 per cent. Morris, in Deaver's clinic, reported 61 per cent acetonuria in postoperative cases.

It would seem reasonable to conclude that in mild cases without shock or hæmorrhage the fall occurs in the first three ways. In hæmorrhage the actual loss of blood from the body would account for an additional loss of bicarbonates. In shock, however, we must look for another cause, for in shock there is the greatest fall in the alkali reserve.

Cannon showed by his work on soldiers suffering from shock that when blood pressures were equally reduced, hæmorrhage alone was not attended by as great a reduction in alkali reserve as was found in shock, and further that the urine in shock cases did not show diacetic acid. The acidosis of shock cases then must, according to this evidence, be due to some alteration of the blood other than the production of acetone bodies. With the development of shock there is an actual loss to the circulation of a large volume of blood, and recent investigation has proved that this blood lies not in the large veins of the body but is stagnant in the capillaries. It is here and in the tissue cells that the carbonates of the blood remain and consequently are out of the circulating blood. For this reason the carbonates are lost to respiration in the tissues.

The increase of sugar in the blood during hæmorrhage and shock has been the subject of investigation for a number of years. Shenck found experimentally that, when hæmorrhage was produced after ligation of the liver vessels,

there was an actual decrease in blood sugar which fact pointed to the liver as the source of the increased supply. Tatum states there appears to be a reciprocal relationship between the rise in blood sugar and the fall in alkali reserve in these conditions. This would seem to imply an effort on the part of nature to supply sugar as the agent to offset the destructive effect of a loss in blood to the tissues of the body. Because of this fact and because of its food value glucose was chosen for the following experiments.

A large percentage of the glucose normally present in the plasma of the blood (0.08 per cent) is not combined but circulates free in the blood and is assimilated in this form without further change. Glucose has a nutritive value of 4 calories per gram, is nontoxic, diuretic, is readily obtained, and easily prepared and kept in stock solution. It is not stored in the tissues as is salt when given in hypertonic solution; nor is there a danger to other tissues such as there is in giving large doses of bicarbonate intravenously. Doyon and Duport, in 1901, and Blumenthal, in 1906, discovered that the rate of utilization of sugar by the tissues depended upon the velocity of injection. Woodyatt and his coworkers have proved by actual experimentation that an individual will absorb each hour 0.8 of a gram of glucose for each kilogram of body weight without glucosuria, and that the rate can be maintained for hours if desired. Thus a woman weighing 65 kilograms (approximately 150 pounds) would receive 52 grams or 208 calories per hour given intravenously. If given by mouth, subcutaneously, or put into the bowel, Woodyatt says glucose does not pass into the blood faster than at an approximate rate of 1.8 grams an hour, which is not sufficient to permit much glucose to escape utilization. The nearest possible approach to a scientifically accurate method of sugar tolerance measurement must be by direct vascular administration. Each tissue then receives its share in proportion to its vascularity, and absorbtion plays no part, as the liver is not necessary for the utilization of sugar in the blood (Fig. 1). If the resting requirement of the patient (of 125 to 150 pounds) is 1,800 to 2,000 calories per day, she will receive in 24 hours 4,992 calories, or more than double the actual need at rest and sufficient for the loss incurred during heaviest work. In an operation of 2 to 3 hours' duration she would receive from 400 to 600 calories, or from ⅛ to ⅓ of the total need for metabolism in 24 hours. Glucose is not only a food and source of energy, but is a stimulant to tissue cells of the body, raising the whole metabolism and thus saving the liver function and restoring glycogen reserves. It not only increases the power of involuntary muscle fiber, but has, according to Lusk, a specific effect on the heart muscle itself.

If glucose is to be injected for several hours, and the rate of tolerance has been exceeded, an examination of the urine one-half hour after the injection has been made will show sugar present in the urine. The effect of sugar, if the rate has been exceeded, is a marked diuresis, and sufficient water should be given to counterbalance the loss of body fluid. If the rate of absorption is adhered to, both the danger of dehydration of the tissues on the one hand and of overburdening the heart with too large a volume of fluid, will be avoided.

The solution of glucose used in our experiments was made from chemically pure anhydrous dextrose and distilled water. A 20 per cent solution was considered as sufficiently hypertonic to avoid hæmolysis and flasks of 250 and 300 cubic centimeters were sterilized in the autoclave and then kept in an ice box near the operating room for emergency use. Injection is made in the vein of the forearm during the operation and the rate of flow regulated by a stop cock on the tube. The rate is easily calculated as follows: If the subject weighs 65 kilograms, the rate is 0.8 of a gram per kilogram and the solution 20 per cent. Multiply 0.8 by 65 by 5 (*i.e.* 20 per cent) equals 260 cubic centimeters per hour. Divide 260 cubic centimeters by 60 (minutes) equals 4.3 cubic centimeters per minute or approximately one flask an hour to the average patient; more of course, if the weight is greater.

Woodyatt has devised a volumetric electric pump by means of which the rate and amount can be accurately gauged, but while its

desirability is great for hospital work, the cost is considerable and any method such as is used for arsphenamine injection is satisfactory. The solution should be given at 105° F. and if it is poured into the container at 115° F. and the tubing placed between two hot water bags, the heat will be maintained throughout the administration. An infusion thermometer in the lower end of the tubing ensures an accurate temperature.

While glucose has been used in this series of cases to combat the acidosis incident to operation, it has also been given with most beneficial results in cases of peritonitis and in exhaustive postoperative vomiting to maintain nutrition. There is in such cases a great loss of fluid from the body in addition to what the patient has lost during operation and metabolism fails because nature cannot utilize the stored protein and fat in the body without water. In such cases an isotonic (5 per cent) or hypotonic (2 per cent) solution may be preferable for a time to restore body fluids, but the blood pressure should be watched that the heart be not overburdened with a large volume of water suddenly injected into the veins. Generally speaking the hypertonic solution (15 to 25 per cent) is preferable intravenously and the Murphy drip 5 per cent glucose given by rectum or saline subcutaneously until the patient is able to take fluids by mouth. It is in the cases of extreme vomiting, of acidosis, either postoperative or in pregnancy, peritonitis and postoperative anuria or uræmia, where, as Crile says, blood transfusion has no value, that glucose intravenously furnishes the means to combat the condition. Litchfield used glucose intravenously in pneumonia with excellent results and found that it has a beneficial action that seems to last beyond the time of injection, due, according to Woodyatt, to the re-establishment of the oxygen supply caused by improvement of the blood flow through the part and the resultant diminution of asphyxial acid accumulation.

So far glucose has been spoken of only in relation to a fall in the alkali reserve occurring in an operation without an appreciable degree of shock. We approach now a condition in which the most marked changes may occur in a short period of time producing, with or without excessive energy transformation, a condition of intracellular acidosis and consequent disturbance or cessation of the interchange of gases within the cells themselves and resulting in interference with intracellular respiration, which is life itself. The histological changes in the cells of the brain, liver, and adrenals appear within a few hours and indicate the profound alteration produced by this state.

As Cannon has shown by his investigation on cases of shock in the trenches, the fall in alkali reserve in shock, unaccompanied by loss of blood from hæmorrhage, goes hand in hand with the fall in blood pressure. If blood pressure can be maintained or the fall diminished, there must be a saving of the alkali reserve, and to this end gum acacia was added to the solution of glucose in one of the series of cases at the Woman's Hospital.

The report of Bayliss, of the Special Investigation Committee, on intravenous injection states that with simple saline solution of any kind the blood pressure falls to a low level by the end of an hour or so and the process continues until death. A secondary fall about an hour after injection sometimes occurs in the case of gum solutions, but it is not so low as that with saline at the same period and the effect is soon overcome.

Bayliss also states that no solution containing salts alone is of much value, as the rise in blood pressure is not permanent. An isotonic salt solution is deleterious, for, owing to the diminution of the colloid concentration in the blood and because of diminished peripheral resistance in the arterioles, the salt solution escapes into the tissues and attracts the water from the blood stream after it. Hypertonic salt solution has same effect after a short initial rise in blood pressure.

Sodium bicarbonate given intravenously, which theoretically should be beneficial, has proved clinically dangerous, as Van Slyke has shown, because of the excess bicarbonate passing into the tissues. To ensure a satisfactory rise of arterial pressure without necessity of introducing a large volume, the presence of a colloid with an osmotic pressure comparable to that of the blood must be used.

Gum acacia (arabinose) is a gum colloid and has been used for shock cases (in 5 to 7 per cent solution) with beneficial results in raising blood pressure. It is a known fact that crystalloids, to which class glucose belongs, when in the blood stream, will attract water from the tissues, and it has been proved, experimentally, by Erlanger and Gasser that this is the effect when glucose is injected into animals and that gum acacia will maintain the expanded blood volume.

Before endeavoring to offset the fall in alkali reserve during operation, it seemed advisable to find the normal variation in women of the carbon dioxide combining power of the blood as the percentages given by Van Slyke (52 to 78 per cent for 100 cubic centimeters of blood plasma) were in men. For this purpose 175 patients were examined on entrance to the Woman's Hospital. The examinations were made by technicians from the Rockefeller Institute and the Van Slyke method was used in each case. The bicarbonate content of the arterial blood plasma is the most accurate measure of the alkali reserve of the body fluids as a whole. On account of the technical difficulty of taking arterial blood for examination, the determination was made from venous blood with only a difference of a fraction of 1 per cent, as Van Slyke has shown. In the usual way for making a Wassermann, 10 cubic centimeters of blood is drawn into a test tube containing a few grains of potassium bicarbonate to prevent coagulation. The blood is centrifuged and the determination of carbon dioxide capacity is made by blowing into the blood plasma carbon dioxide to the saturation point; in other words, it is the determination of the number of cubic centimeters of carbon dioxide gas which 100 cubic centimeters of blood plasma will take up. The result is expressed in volumes per cent of carbon dioxide. The procedure is relatively simple and requires only 4 to 5 minutes. The results obtained were as follows:

Percentage	Cases	Total
45.8 to 50	6	..
50.0 to 55	10	25
55.0 to 60	60	
60.0 to 65	61	
65.0 to 69.9	20	150
Total		175

Eighty-five per cent of the patients had a carbon dioxide combining power of the blood between 55 and 70 per cent.

Of the 6 cases between 45.8 and 50 per cent, 4 cases were of inoperable carcinoma of the cervix with extensive involvement; 1 was a patient who had had severe hæmorrhage and had a hæmoglobin of 23 per cent. The 19 cases between 50 and 55 per cent included 2 cases of pregnancy, 1 with pulmonary tuberculosis; 2 of subacute appendicitis; 3 with menorrhagia following abortion. No one of these cases would have been considered clinically to have been more than a fair risk. The other cases were on other divisions and the history is not known.

The carbon dioxide combining power of the blood was then ascertained for 50 patients under 50 years of age, with a temperature not above 99°, pulse below 90, and hæmoglobin 85 per cent, or above, with the result as follows:

	Woman's Hospital, New York	Van Slyke's Figures for Men
Lowest	55.2 per cent	52 per cent
Highest	68.9 per cent	78 per cent

Forty of the 50 patients had a combining power of 60 per cent, or above.

It would seem therefore that the upper limit in women is about 8 points lower than in men (52 to 78), which corresponds to what Van Slyke has estimated, but that the lower limit in women is not so low as in men. As 50 is the figure Van Slyke has put below which an acidosis probably exists, and which seems to hold true clinically for women, this shorter range may mean that acidosis occurs more frequently in women, for we know that acetone bodies are more often found in the urine of women after operation than in men.

The shorter range between the normal limits in women is the reason why acetone bodies are more frequent in pre- and postoperative urine. If the upper limit of the carbon dioxide combining power is lower, the range is shorter, and the danger line sooner reached. In 10 of Cannon's series of shock cases operated upon in the trenches, the carbon dioxide capacity before operation was 40 per cent or less and in two of the cases the capacity fell after operation to 27 and 28 per cent. Cannon states that blood taken

COMPARISON OF VAN SLYKE AND WOMAN'S HOSPITAL FIGURES

	Van Slyke's Figures for Men	Woman's Hospital Figures
Limit of bicarbonate reserve in normal resting adult	53 to 80 per cent Range 27	55 to 70 per cent Range 15
Limit of bicarbonate reserve in adult with no pronounced symptoms	40 to 53 per cent	50 to 55 per cent
Limit of bicarbonate reserve in adult with moderate to severe acidosis—symptoms may be apparent	30 to 40 per cent	45 to 50 per cent
Limit of bicarbonate reserve in adult with severe acidosis—symptoms of acid intoxication	below 30 per cent	below 45 per cent

from the heart at the moment of death from shock has a carbon dioxide capacity between 20 and 24 per cent. In the series of cases operated upon in the Woman's Hospital, the condition was critical when the alkali reserve reached 42 per cent or 44 per cent. Blood taken from two patients shortly before death showed 27 and 28 per cent. This would seem to indicate that in women not only is the carbon dioxide combining power of the blood plasma not as high as in men but that a critical state is reached earlier in the scale than in men.

Examination of the blood taken at the end of operation was made in 100 cases to ascertain the fall in alkali reserve incident to the operation. The anæsthetic given was nitrous oxide gas and ether, by the closed method. Only one bag of gas was used and the amount of ether varied from 2 to 17½ ounces. The duration of anæsthesia varied from 30 minutes to 3 hours 15 minutes. The operations were gynecological and included plastic and abdominal work and were done by ten different operators. One hundred cases examined both before and at the end of operation showed a fall in alkali reserve varying from 0.7 per cent to 22.2 per cent.

Austin and Jonas reported a fall in alkali reserve during operation as follows: lowest 4 and highest 18 per cent; Reimann and Bloom, lowest 5, highest 15; Morris from Deaver's clinic, lowest 0.4, highest 22.7; Cannon on cases operated upon in shock, lowest 6, highest 19 per cent. Clinically when the fall reaches 15 or more points, the patient shows symptoms of beginning shock as evidenced by falling blood pressure, rapid pulse, and increased respiration.

One hundred cases examined both before and at the end of operation showed a fall in alkali reserve from 0.7 to 22.2 per cent. In 14 of the cases the alkali reserve fell 15 or more points. The incidence of acute acidosis during operation is 14 per cent.

To ascertain the effect of glucose feeding on vomiting, 20 patients were given glucose solutions (20 per cent) intravenously, the amount varying from 24 to 72 grams according to body weight and duration of the operations, which lasted from 1 to 3 hours (anæsthesia). The cases were the most critical of the series including 2 Wertheim, 4 Mayo, 2 enteroceles, 1 resection of bowel for carcinoma of sigmoid, 3 cases of hæmorrhage, 3 large fibroids, and 1 large, densely adherent, intraligamentous cyst. The result was that vomiting was entirely absent in 16 cases, and nearly so in the other 4 cases—the amount was only 1 to 2 ounces and occurred not more than 4 times in any case.

During the same period of time 10 cases, less critical in type, were operated upon by the same two operators with anæsthesia varying from 58 minutes to 2 hours, 15 minutes in duration. Only 2 cases had a correspondingly slight amount of vomiting while the other 8 cases vomited from 24 to 59 hours.

A comparison was then made between the fall in alkali reserve, blood pressure, pulse pressure, pulse rate and respiration in 20 cases operated upon without appreciable shock. The duration of operation varied from 51 minutes to 3 hours, 6 minutes. The amount of ether used was from 3 to 17 ounces. The fall in blood pressure is a more reliable guide during operation to pending shock than is the alteration in pulse rate and respiration, inasmuch as it is the cause upon which that alteration depends. The comparison showed a fall in alkali reserve in the 20 cases of 0.7 to 11.7 per cent; in blood pressure 4 to 50 points; in pulse pressure, 4 to 20 points in 6 cases, 5 to 40 points in 10 cases, remaining the same in 4 cases; the pulse rate remained the same in 1 case, increased 4

to 40 beats in 14 cases, fell 8 to 26 beats in 5 cases; respiration remained the same in 10 cases, was increased 2 to 10 in 9 cases, and lessened 4 in 1 case. The fall in blood pressure bears a close relation to the fall in alkali reserve. The change in pulse rate and respiration is not constant.

The next and final step in the study was to see if blood pressure could be maintained during hæmorrhage or shock. The reports from the British Special Investigation Committee on Surgical Shock, on intravenous injections to replace blood and particularly upon the use of intravenous injection of gum acacia in surgical shock, led to the following procedures.

Bayliss, and later Drummond and Taylor, used a 5 to 6 per cent solution of gum acacia in salt solution of different strength. As I believed that beneficial results had been obtained by glucose solution I added 6 per cent gum acacia to the glucose and gave the combined solution. I found later that Erlanger and Gasser had used this same solution, but with a higher percentage of glucose (30 per cent). Salt or bicarbonate of soda was not added to the solution for the reason, as Erlanger says, that the fluid is introduced so slowly that the water attracted to the blood stream by the crystalloid sugar brings salts with it. Absolutely no harmful result has occurred to the patients in any way. Three of the patients who had been given glucose intravenously in the wards for postoperative vomiting, had chills, due to the fact that the solution was injected too rapidly. There were no other complications. No patient who has been given during operation intravenous injections of glucose or gum glucose solution and the rate of injection has been directly under observation, has had chills.

Patients were given 6 per cent gum acacia and 20 per cent glucose at subtolerant rate just as described previously in giving the glucose solution, because they were low in carbon dioxide combining power, were frankly bad risks, or had had a hæmorrhage. In 2 cases of 250 and 255 blood pressure, respectively, where the solution was not given until the blood pressure had fallen 100 points, the pressure then fell only 10 and 15 points lower on administering the solution, and 1 hour after operation was above the point where it was when the solution was begun. Two cases in which the solution was started late, after severe hæmorrhage and the blood pressure had dropped 30 to 45 points, showed 1 hour later, 10 and 12 points above the blood pressure findings at the beginning of operation. One case of 3 hour anæsthesia, with large, densely adherent cyst of the pancreas, dropped 12 points. The other 32 cases were from 2 to 30 points higher at the end of operation, and only 3 of the above cases showed a fall in alkali reserve, of 15 points.

Of 40 cases which were given gum glucose after hæmorrhage or in prolonged operations, the blood pressure dropped only 1 to 15 points in 8 cases, and in 32 cases the blood pressure was the same or from 2 to 30 points higher at the end of operation.

Six per cent gum acacia in 20 per cent glucose solution will help to maintain blood pressure if given throughout an operation.

TECHNIQUE OF PREPARATION OF GUM GLUCOSE SOLUTION

(From the Laboratory of the Woman's Hospital)

6 per cent Gum arabic
20 per cent Dextrose
0.9 per cent Sodium chloride

Procure gum arabic, grade A. Kordofan or Egyptian, in powdered form, which will go into solution more readily than the crystalline form. If the gum is in lumps, considerable time will be saved if it is ground before attempting to dissolve it.

Chemically pure anhydrous dextrose is used for the solution. There are several varieties of "pure" dextrose which are much cheaper but greater care must be exercised to remove impurities or a heavy deposit will remain after the final sterilization.

For 1 liter of gum glucose solution weigh out 250 grams chemically pure anhydrous dextrose and 60 grams gum arabic. Suspend the gum in 300 cubic centimeters normal salt solution, stirring until most of the gum has dissolved and then let stand in a refrigerator over night completely to dissolve the residue. The following day dissolve the 250 grams of dextrose in sufficient warm salt solution to make a total volume of 625 cubic centimeters and filter through cotton. The excess quantity of solution is necessary to counteract the loss due to the filtration.

Add 500 cubic centimeters of the dextrose solution to the gum solution, and mix. Then make up to 1 liter with normal salt solution. Place in a boiling water bath for ½ hour, stirring frequently. This heating will dissolve the gum completely and will also precipitate out impurities in both gum and dextrose.

Again make up to 1 liter with normal salt solution. Titrate the reaction and neutralize with 10 per cent solution sodium carbonate, (approximately 15 cubic centimeters of 10 per cent sodium carbonate solution will be required per liter). This must be done since the solution has been found to be quite acid (arabic acid).

Autoclave for 15 minutes, at 15 pounds pressure which will precipitate a quantity of solid matter. Care should be observed to have the solution subjected to the same degree of heat as in the final sterilization or a clear solution cannot be obtained.

Filter through cotton and then through a Buchner filter, using two layers of linen and two of hard filter paper, Whatman No. 50, arranged alternately and moistened on the filter with saline solution (in layering start with linen). The linen serves as a support for the paper which otherwise would be sucked through the holes of the funnel under the pressure applied.

Divide into 250 and 300 cubic centimeter lots, which are convenient amounts, and pour into clean sterilized Erlenmeyer flasks and autoclave for 15 minutes under 15 pounds pressure. If the solution is clear and free from sediment it is now ready for use. If the gum glucose solution is not to be given immediately, the flasks must be placed in a refrigerator where the solution will keep for a long time ready for emergency use.

Before closing mention should be made of other tests for acidosis, and of the prophylaxis, and the postoperative treatment of this condition.

While it is believed that Van Slyke's test for the alkali reserve gives the simplest and most accurate means of ascertaining the acid base balance of the body, still an effort should be made, especially when the carbon dioxide combining power is low, to study the patient from all angles and treat him so that he will be able to withstand a surgical operation. To this end the patient's metabolism and eliminative processes should be determined and an effort made to limit the production of acid by-products and to increase their elimination.

Acid by-products result from a deficient supply of carbohydrates or an excess of protein which gives rise to acid-forming elements and thereby depletes the stored bases of the body. The diet before operation should consist chiefly of starchy foods together with vegetables and the citric fruits, which are changed to carbonates in the stomach. Shigenoba has shown by experiments that the kind of food has a marked influence upon the acid-base equilibrium of the organism. Though the carbon dioxide capacity of the plasma is 61 to 64 in green diet, this value is reduced to 48 to 53 on protein diet—the hydrogen-ion concentration of the blood remains constant with both kinds of diet. The postoperative diet should be of the same character,—fruit juices or fruit albumen, cereals (not oatmeal), citric fruits, honey, sugar, starchy foods, and vegetables. As starvation is a cause of acidosis, food should be given up to a short time before operation and feeding begun early after the operation. Bicarbonate of soda is of undoubted value in raising the alkali reserve if given for several days preceding the operation.

As the alkalinity of the blood is maintained for the most part by the tubules of the kidney, it is of great importance to know their ability to eliminate acid by-products. In health the effete nitrogen of the proteid molecule is used to make ammonia salts and combines to form urea, but with an excess of acids the ammonia is used to neutralize them and consequently escapes conversion into urea. In health the ammonia nitrogen represents about 2 to 7 per cent of the total nitrogen, but in acidosis it is usually over 10 per cent and may in severe acidosis rise to 20 or 30 per cent. It is not until all the ammonia is combined that the acetone bodies appear in the urine. The importance of examining then for acetone bodies is evident especially in women. Caldwell found acetone bodies in 23 per cent of his cases before operation. The soda bicarbonate tolerance test of Sellard is a valuable aid in estimating the amount of alkali necessary to render acid urine alkaline. In health 10 to 15 grams of bicarbonate of soda will make the urine alkaline in 8 hours but with an excess of acid in the urine the amount is greatly increased and an estimate may thus be made of the total acidity by the amount of soda bicarbonate required. The phenolphthalein test, while it shows a wide variation, points to a condition of acidosis when the total output of urine in 2 hours is 30 per cent or less.

The respiratory capacity of the lungs may be further studied by estimating the carbon dioxide tension in the alveolar air and by the simple test of Yandell Henderson for acidosis, *viz.*: the ability to hold the breath for the normal period of forty seconds.

The intestinal tract and the sweat glands of the body should be considered as important

factors not only in carrying off waste products but for the loss of fluid to the body.

Purging shortly before operation and post-operative vomiting remove a large amount of water from the tissues thus predisposing to acidosis. Patients in the calorimeter eliminate water through skin and lungs (DuBois) at a rate which varies between ½ and 1 liter a day. In active exercise or nervous excitement the amount is greatly increased. Benedict quotes the case of a foot ball player who lost 14 pounds in a game 1 hour and 10 minutes long; ¼ pound due to oxidation of solids, 13¾ pounds water lost.

The patient who at the end of operation has saturated the coverings above and below with perspiration greatly needs the addition of fluid which may readily be placed in the bowel (1–1½ quarts) while the patient is unconscious to offset this loss of fluid to the tissues, and a further addition of fluid intravenously, subcutaneously, or by Murphy drip, as the need may be, is an aid of metabolism.

SUMMARY

1. Acidosis is a term used to signify an impoverishment of the body in bases.

2. The alkali reserve (bicarbonates of the blood) is the criterion of the acid-base balance of the body.

3. The determination of the alkali reserve (*i.e.* the number of cubic centimeters of carbon dioxide gas which 100 cubic centimeters of blood plasma will take up) is readily made by Van Slyke's method.

4. A high carbon dioxide combining power of the blood is of the greatest importance for the maintenance of lung ventilation during operation.

5. The range of the carbon dioxide combining power of the blood in women (150 cases) is 55.2 cubic centimeters to 69.9 cubic centimeters per 100 cubic centimeters of the blood plasma or about 8 points lower than Van Slyke found for men.

6. As the range is shorter in women the danger line is sooner reached which accounts for the greater frequency of acidosis following operations in women than in men.

7. The fall in alkali reserve during operation depends not only upon the anæsthetic and the duration of the operation but upon the nature of the operation and the occurrence of hæmorrhage and shock.

8. The fall in alkali reserve bears a close relation to the fall in blood pressure and pulse pressure. If the fall in blood pressure is prevented, there is a saving in alkali reserve.

9. A solution of glucose given intravenously during an operation at the rate of 0.8 gram of glucose for every kilogram of body weight each hour of the operation will lessen the acidosis incident to operation by promoting metabolism, prevent or diminish the vomiting, and promote diuresis.

10. Glucose will appear in the urine in one-half hour if the rate has been exceeded.

11. A solution of gum acacia (6 per cent) in glucose (20 per cent) if given at a subtolerant rate the entire time of operation is an aid to the maintenance of blood pressure.

12. Carbohydrate feeding before and after the operation together with the use of bicarbonate of soda will do much to prevent or lessen acidosis.

CONCLUSION

Every well equipped hospital laboratory should have a paid physiologist who could devote his time to the study of problems on the living tissue as the pathologist does on the specimens removed. The study should cover organic regulation as a whole and not individual cells or tissues. Biology would not then be divided into its branches but would comprise a study not only of anatomy and pathology but physiology and biological pharmacology as well. The problems should be of practical import, of like value to patient and surgeon. The student should have made known to him the facts of general metabolism and their relation and importance to surgery. This information should not be isolated and scattered but grouped and given as a part of student work preparatory to surgical training.

As we bring a more scientific spirit to surgery we approach to what Haldane terms the humane physiology, for it is only by a study of life that we know the living and can give the sympathy and understanding which is as much a duty as is the technical skill for the true surgeon.

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SUPERFŒTATION OR SUPERFECUNDATION?[1]

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IT was the writer's good fortune to receive an interesting specimen of a double (twin?) pregnancy in which the two fœtus were of such greatly different sizes and stages of development as to lead to the conclusion that the specimen represented an instance of superfœtation. As there has been considerable controversy on the subject and as many arguments have been presented, pro and con, with numerous cases to uphold the various arguments, I was interested in looking up the literature in studying my case.

According to some writers superfœtation is an impossibility, and all such reported cases, according to their view, are cases of superfecundation in which the smaller fœtus either died early or was markedly retarded in its development. Such views are expressed by Schultz, Godlewski, Kuntz, and others.

At present, superfœtation means a second impregnation of a female already pregnant.

Superfecundation is the impregnation of two or more ova of the same stage of development by coition at different times.

Superfecundation according to Mertens means a second impregnation of one already pregnant, but before the decidual membrane is formed. By superfœtation he means a second impregnation after the decidual membrane has been formed.

According to Marshall superfœtation is a condition in which fœtus of different ages may be present in the same uterus. There is no mention of the necessity of a second coition. According to him if ovulation takes place during pregnancy and if, owing to the occurrence of coition, the ovum becomes fertilized, then the phenomenon of superfœtation takes place. The ova belong to different periods of ovulation.

According to King superfecundation consists of the fertilization by successive matings of ova belonging to the same period of ovulation. Superfœtation is due to the fertilization of ova of different periods of ovulation followed by copulation occurring during pregnancy, which leads to the simultaneous development of two sets of ova. This involves a second coitus and a second ovulation.

Sumner, on the other hand, believes that superfœtation may be the result of a second coitus, but not necessarily so. In mice the sperm may be retained in the female for a

[1] From the Daniel Baugh Institute of Anatomy.

long time and still be functional and produce superfœtation.

Harmon considers superfœtation as a condition in which the uterus contains fœtus of different degrees of development, due to either a second coitus or not.

In analyzing the foregoing, there is a difference of opinion as to whether a second coitus is necessary or not. If this is necessary in all cases, then the chances of a superfœtation are rather limited. On the other hand, the cases of a second litter of young (in some animals) following in a short time a first litter, without a second copulation, would be impossible of explanation except through the longevity of the sperm in the genital tract of the female. Here only one intercourse prevailed, so that the persistence of sperm must be considered. How long sperm will live in the female genital tract under normal conditions is not known, but in lower animals no doubt it lives for quite a time. In the hen it is said that the sperm lives for 5 weeks in the genital tract, so that several weeks may pass and ova may still be fertile after having been tread only once by the male. In mice a second litter is occasionally born without a second coitus. The sperm of man may be kept alive for several weeks upon a warm stage, under proper conditions, and Duehrssen and Zweifel found living sperm in the oviduct removed from a woman, in which instance it was positively stated that there had been no cohabitation for 4 weeks. If this can occur in a human female, it seems possible that an ovum of a successive ovulation period might readily be fertilized, producing superfœtation.

Bearing this in mind it would be well to leave the question of a second coitus open, for if the sperm would live 4 weeks, it might live longer. Of course, we know nothing of its ability to fertilize an ovum after such a time, nor can we positively say that it will not fertilize an ovum after that time. Another factor to be borne in mind is the viability of the ovum. It is generally believed that the ovum soon loses its power of chemotaxis, so that if not fertilized by the end of 7 days it undergoes degeneration and is not capable of being fertilized and of developing. Some are inclined to believe that the egg may live much longer and if it would live from one ovulation period to another, then its fertilization would be a superfecundation with a difference in the developmental stages of the two fœtus. It is no doubt true that the ovum lives only about 7 days. We might, therefore, modify Block's views and define the two terms as follows:

Superfecundation is that condition in which two or more ova belonging to or originating at the same ovulation period are fertilized by sperm from coitus practiced at different times by the same or another male. The ova may originate from one or both ovaries, but in the latter case the ovulation must be practically simultaneous.

Superfœtation is the fertilization of two or more ova that belong to or originate at different ovular periods by sperm from coitus at the same or different times, by the same or another male. This imposes a pregnancy superimposed upon another by the fertilization of an ovum of a later date, by the same or another male. Both fœtus develop in the same uterine cavity, but are of noticeably different ages. The writer would desire to insist upon the fact that one coitus may suffice for the double purpose.

Having established an understanding as to the interpretation of the term superfœtation, it will next be necessary to consider the evidence for and against its occurrence. This condition has been the subject of discussion and controversy from earliest times as we find it discussed by Hippocrates, Aristotle, Pliny, Schenck, Schacher, La-Chausse, and others. As superfecundation is so closely related to superfœtation, it will be of interest to consider that phase first and then to present the reasons for and against superfœtation.

According to Mertens there are a number of factors underlying the condition of superfecundation: (1) An ovum may have two yolks; (2) graafian follicles may have two ova; (3) in the same ova two or more follicles may mature at same time; (4) both ovaries may ovulate at same time, giving rise to two or more ova. In the first case it seems impossible that both yolks would not be fertilized at the same time so that superfecundation would result.

In the second and third instances superfecundation might readily occur. The ova might be fertilized simultaneously and show analogous developmental stages, yet again successive fertilizations may occur, tending to give different developmental stages of the various fœtus.

In the fourth instance there is the greatest possibility of superfecundation. In this case the sperm may go up only one oviduct and this is most probably if the uterus is double. Although this is rare in human beings it has been proven, when due to intercourse with different individuals, especially of different races. Again, if there be a difference in the size and apparent fertilization of the two products of conception, they must always be considered instances of superfecundation if there has been but one coitus.

The condition of superfecundation is quite common in lower animals and is frequently met with in man. In fact, some consider all cases of superfœtation instances of superfecundation, stating that the latter is an impossibility. Many interesting cases are cited and some of these will be mentioned.

In lower animals superfecundation is well shown in those animals that give rise to hybrids. This is especially true in those animals with double uterus, yet in ruminants and ungulates it does not commonly occur. The mare will take the stallion or the jack, and cases are on record where mares have foaled a colt and a mule, having been successively mated to the stud and a jack. Again, a bitch may give rise to a mixed litter, indicating copulation with different dogs.

Among human beings there are also many cases on record and the most interesting will be mentioned.

Mercer cites the case of a negress who was married to a white and gave birth to a negro boy and a white girl.

Debouillon mentions a negress who gave birth to two well-developed males of equal size, one a negro and the other a mulatto. She confessed to intercourse on the same night with a negro and a white man.

Moseln states that a negress in Jamaica gave birth to two children of the same size, one a negro, the other a mulatto. She stated that she had had intercourse with her husband and shortly thereafter with a white man.

A similar case is reported in the *Gazette de Sante*, June, 1821.

Gare gives an instance of a white woman who had had intercourse with a white man and after due time gave birth to twins, one black and one mulatto.

Buffon cites a case that occurred in Charleston, South Carolina, in which a white woman gave birth to twins, one white and the other black. She stated that she had been forced into having intercourse with a negro just after her husband had had intercourse with her and left her.

Dewees cites the case of a white servant girl who gave birth to twins, one white and distinctly European in appearance and one black, with a distinct negro constitution. Although she did not admit an intimacy with a white and a black man, nevertheless as soon as the birth of the twins was known, a white and a black man who worked on the same farm, hurriedly left the neighborhood.

Bloch cites the case of an Indian woman who gave birth to triplets, one an Indian, one a Caucasian, and one a negro. She later confessed to intercourse with men of these three races in the order named.

SUPERFŒTATION

As previously stated, there are some who positively deny the possibility of the condition of superfœtation and explain such cases on the basis of retarded or arrested development of an ordinary twin pregnancy. According to Beck, Brassavolus, who lived between 1500 and 1555, said he had known superfœtation to be epidemic. While such a condition is extremely doubtful, it shows to what extent beliefs are sometimes carried. The reasons and arguments against the possibility of its occurrence will be first stated, then each will be discussed and interpreted.

1. By the seventh to the eighth day after fertilization, the ovum is usually in the uterus and the internal os and the oviducts are closed by a decidual mucosa. Soon a mucous plug forms in the cervical canal and as a result of these changes it is impossible for sperm to pass up the genital tract. Homs, Burns, and Magendie have shown that sometimes the ovum does not descend until the eighth, fifteenth, or twentieth day after fertilization (Cassan).

In reference to the mucous plug it might be said that it does not always form. Even Herzog, who did not favor superfœtation, states that he believes that the mucous plug is not an obstacle to the advance of sperm

and that it also is not found connected with pregnancy only, as it forms in the cervical canal of non-pregnant females also. Also cases have been noted in which the orifices of the oviducts were patent even in the third month. Haller even denied the existence of a mucous plug in pregnancy (as an indication thereof and a necessary sequela of fertilization); Hildebrandt and Valentin do not even mention it. Loeb also believes that the mucous plug does not form a positive barrier, but he believes that as pregnancy advances, the oviducts become closed, in lower animals especially. In addition, occasionally during pregnancy, the menstrual cycle continues and this fact would indicate an open passage. It was also formerly believed that the ovular decidua and decidua vera were soon (by end of the third month) fused and thereby closed all communication between the cervical canal level and the orifices of the oviducts. This is now looked upon as wrong as Minot showed that the ovular decidua (d. reflexa) degenerated early and becomes nought but a structureless, hyaline membrane. This was later confirmed by Herzog, so that a thin space might exist between the decidua vera and the ovular decidua, in early stages of pregnancy, and the sperm might readily work its way up to the oviduct therethrough.

Campbell states that occasionally during the second to the third month the mucous plug comes out and the intra-uterine space between the ovular decidua and the decidua uterina, is re-established so that the oviduct may be reached.

From the foregoing it would seem that in many instances the genital passage does not completely close during the early months of gestation, so that as late as during the third month it would seem that sperm could reach the oviduct, at least in some cases.

2. Typical ovulation ceases during pregnancy, that is to say it is so claimed by the adversaries of superfœtation. In connection herewith Lusk says that the idea that impregnation could occur at two periods distant from each other must be regarded as an inadmissible hypothesis until physiologists succeed in demonstrating, by corpora lutea of different ages, that ovulation occurs during pregnancy. Parvin also believes that ovulation probably ceases in pregnancy, also that if an ovum is liberated it cannot enter the oviduct as the decidua would have closed the orifice of the oviduct and with the mucous plug would prevent the sperm from getting to the ovum. The latter two points have already been discussed.

Whether ovulation invariably ceases at pregnancy in all cases is doubtful, but that it does cease in most cases is conceded by most writers. In lower animals it has been found that ovulation may occur during pregnancy.

The corpus luteum resulting from a ruptured graafian follicle does not atrophy and disappear at the end of a few weeks, as the ordinary corpus luteum spurium does, but continues its existence up until the eighth or ninth month of gestation. It has a number of functions as follows: (1) inhibition of ovulation during pregnancy; (2) assisting in the implantation of the ovum in the uterine mucosa; (3) stimulating the formation of a menstrual decidua; (4) stimulating the mammary gland to lactate; (5) and in the regular course of events it is said to cause menstruation; (6) it is also supposed to prevent the lodgment, or implantation and development of another ovum in the uterus already occupied by a fertilized ovum.

Christopher found that ovulation does occur in the cat during pregnancy of that animal. In a cat advanced in pregnancy he found four mature graafian follicles, each containing a mature ovum. This condition may occur during pregnancy in the mare also. He also cites Pouchet's case of a pregnant cow that had three corpora lutea in one ovary and two in the other and these were all at different stages. In addition to the large fœtus there was a smaller one of about 2 months of age. Longley found that coition was necessary to ovulation in the cat and particularly to maturation, therefore, a second coitus would be necessary for a second ovulation.

Loeb has shown, in guinea pigs, that pregnancy does not prevent an early ovulation if the corpora lutea were excised so that if the corpus luteum of pregnancy should undergo early involution, then ovulation could readily occur and superfœtation also.

Loeb performed a number of experiments upon guinea pigs in order to determine the influence of the corpus luteum. If a cut be made in the uterine wall or a foreign body be introduced into the lumen, 4 to 8 days after ovulation, then a placentoma will be formed. On the other hand the extirpation of the corpus luteum, early after ovulation, will prevent the formation of a placentoma. If the corpus luteum be removed within the first week after ovulation, then there will be a marked decrease in the sexual cycle of the guinea pig. He believes, therefore, that the corpus luteum inhibits the rupture of the graafian follicle. A periodic change that occurs in the uterine wall corresponds to the various phases of the sexual cycle. Pregnancy need not prevent early ovulation, after excision of a corpus luteum, but it does prevent the setting up of a new cycle in the uterine mucosa. Pregnancy, therefore, exerts an inhibitory influence on cyclic changes of the uterine wall, while it does not affect an early ovulation taking place after the excision of the corpus luteum.

Frankel, in 1903, experimented upon the corpus luteum of pregnant rabbits in order to determine the effect of destruction of the corpus luteum. He states that the destruction of the corpus luteum will cause the death and absorption of the conceptions up to the twentieth day of pregnancy.

Christopher believes that often an ovum is liberated near delivery of the child, as evidenced by instances of coition a week after delivery followed by pregnancy. Berthold also mentions a case in which a woman delivered of her child had intercourse with her husband 8 days later and this resulted in another birth 285 days later.

Of great interest is the case of Cosentino—a woman who died during the sixth month of pregnancy and exhibited a recent corpus luteum. He states that at present we do not know positively whether the development of the graafian follicle during pregnancy is sometimes interrupted or whether it suffers any special changes. Most authors on the subject, however, state that the change is a continuous one, extending over a period, yet he himself thinks the evidence is not yet sufficient to be positive. An examination of the specimen showed many follicles in which not only the various stages from the early to the mature follicles were present, but also proof of a ripe, ruptured follicle. The follicle measured about 15 millimeters in diameter and its edges were serrated. The theca had a rich network of arterial and venous vessels and at one side of the follicle among a lot of granular débris, was a ripe ovum with all its parts. So it seems that even in the human type the ovaries may carry on their function of maturation of the follicles to bursting of the follicles.

Mayrhofer contends that the corpus luteum of pregnancy, like the false corpus luteum of menstruation, disappears and is replaced by another at short intervals and that the belief that the corpus luteum of pregnancy lasts from 9 to 12 months is false. In support of this he mentions cases, or deaths following rupture of tubal pregnancy of 7 to 8 weeks' duration in which the corpus luteum is described as communicating with the peritoneal cavity by an aperture not yet cicatrized. The cases cited by Mayrhofer are from Luschka (1), Kussmaul (2), Tobege (1) and G. Braun (2). Mayrhofer considers these recent corpora lutea because, as he claims, if they were old, the apertures would not be open so long. On the other hand this description fits that of the case reported by Benham—a girl died during menstruation and the graafian follicle undergoing involution had all of the characteristics that a corpus luteum of pregnancy should have.

The question of corpus luteum of pregnancy seems to be a testy subject. The presence of a corpus luteum of apparent long standing was supposed at one time to lend weight to the theory of pregnancy, in medico-legal cases, but with the finding of an apparent corpora lutea vera in unquestionable virgins and the absence of a real corpus luteum in pregnant females after the fifth month, the importance of the significance of a well developed corpus luteum lost weight. So it seems that the corpus luteum changes are quite variable and the early involution of such a body might readily permit the maturation of another follicle and the liberation of another ovum dur-

ing the early months of a pregnancy, thereby permitting superfœtation.

It might be said that the implantation of an ovum and the development of another decidua in an already occupied uterus would seem the most serious handicap to superfœtation. If pregnancy and a corpus luteum verum inhibit cyclic changes in the uterus, then superfœtation cannot occur. Yet the adversaries to superfœtation admit that the uterine mucosa might be stimulated so as to form a mucosa.

Sertori (1906) after histological observations stated that a second ovum may become implanted in the uterine mucosa, while the decidual reaction is still slight, that is, during the early stages of pregnancy. Loeb, on the other hand, from experimentation upon guinea-pigs drew the conclusion that the uterine mucosa of pregnant guinea-pigs could not be stimulated to form a new decidua. He considered that an inhibitory influence was exerted during pregnancy, on the cyclic changes in the uterine wall; consequently the implantation of an additional ovum, in a uterus already pregnant, becomes impossible.

The connection between ovulation and menstruation is close according to some and not according to others. They are not necessarily synchronous, but in most cases menstruation is dependent upon ovulation. In most cases it is generally conceded that in general ovulation begins at about the same time of life and ceases at about the same time and for about 35 years they go on steadily hand in hand. Of the two processes menstruation is the less dependable. As stated above, one of the functions of the corpus luteum seems to cause the second succeeding menstrual flow. This function, however, may not be regular. There are cases on record in which pregnancy occurred before menstruation began (at 8 years of age) also after menstruation had ceased (several decades, 103 years. —Bloch). Again, some women never menstruated and yet have borne children. Some have been regular before the first pregnancy and irregular thereafter. Also some have menstruated only a few times a year and yet have become pregnant. In some instances menstruation has not occurred until after the first child has been born. So it seems that menstruation while a usual process in the normal, physiologically healthy female between the ages of 15 and 50 may be irregular, or absent, and yet not interfere with childbirth. Yet in all ovulation has taken place. Autopsies on women who have never menstruated showed the corpora lutea and alba, etc. That menstruation ceases at pregnancy through the inhibitory action of the corpus luteum verum may also at times be doubted. Menstruation in pregnancy up to as late as the fifth month has been known to occur. Also regular and irregular flows of blood have been known to occur during pregnancy, apparently indicating that the process of ovulation has continued. Some are inclined not to consider these discharges of blood from the uterus of pregnancy as true menstrual discharges, no matter whether they occur regularly or not. Of course, such an interpretation is too sweeping if it considers menstruation a periodic discharge of blood from the uterus without the presence of the product of conception.

The complete removal of the ovaries will in itself inhibit menstruation so that this process depends for its occurrence on the existence of maturing graafian follicles.

Bloch states that some women after bilateral removal of ovaries and tubes have continued to menstruate. That, to the writer, is open to serious question. It is not a real menstruation, but an erratic hæmorrhage, due to some other cause, or, what seems most likely, indicates the incomplete removal of the ovarian tissue; this is rather fortunate as it prolongs the changes due to the radical operation and rather ameliorates a too rapid and early menopause.

3. It is claimed that the oviducts of the pregnant individuals are too short suitably to apply themselves to the ovary so as to receive the newly ovulated egg. Also in pregnant animals, including human beings, the ciliary action ceases immediately with the onward movement of the ovum.

The first point could not readily be advanced as an argument against superfœtation in the first 3 months, as the enlargement of the uterus would hardly be sufficient to cause this change. In fact we know so little about

this that it does not come in very well as a point especially against the possibility of superfœtation. It has also been shown that ciliary action does not cease after the passage of the ovum.

4. It is also maintained that a pregnant uterus softens and varies so from the normal in function that it is unfit for its calling, so that a newly fertilized ovum could not continue to develop therein.

This statement seems a little rash and hasty as the uterus retains its capabilities often in various degenerations or deteriorations. Loewenhardt, in Prenzlau, reports a number of cases of conception and natural births in instances of uterine cancer. Adelmann reports a 46-year old woman afflicted with dropsy of the uterus, who, during the first 5 months of pregnancy, lost 5 to 12 quarts of water every 4 or 5 weeks. At birth she lost two pails full and gave birth to a living child. Stoll found in the uterus of a woman in childbirth (one who had passed the normal termination period) a twelve-inch polyp that weighed one pound and one-half ounce.

5. It is also claimed that through pressure within the uterus, due to the development and growth of the fœtus, maturation of another graafian follicle is impossible. Many experiences prove against this assertion. The presence and pressure of a hard body in the uterus is not sufficient, as is shown by the presence of polyps, dead fœtus, etc. These do not prevent the development of the uterus and the maturation of the graafian follicle. Haller reports many such cases in animals and human beings. Also there are many cases of extra-uterine pregnancies in which the fœtus died and became calcareous and encapsulated and was retained. Uterine pregnancies occur later in spite of this condition. W. Campbell collected evidence of such cases and found that nine with retained pregnancies became pregnant once; two, twice; one, three times; one, four times; one, six times; and one, seven times.

6. Another argument is that if superfœtation were possible, it would occur more often. This seems rather weak. Simply because it does not occur often, does not mitigate against its ever occurring. The discussion arising is not with reference to how frequently it can occur, but as to whether it ever occurs even though but once in a century. The mere fact that extracorporeal heart occurs very rarely, does not mean that it never does or cannot occur. The mere fact that cyclops is very rare does not signify that it cannot or does not occur. It is merely taking a stand that because a certain individual has never seen a certain thing, that thing does not exist. It places the one who advances such an argument in the position of the farmer who saw a giraffe for the first time, as he said "there ain't no such animal."

Dewees in 1823 states that although there were many cases of superfœtation on record at that time, this phenomenon was considered impossible. The main reason advanced was that the cervical os was closed by mucous plug after fertilization and so the passage was blocked; yet for those authentic cases some explanation had to be given, as will soon be considered. Other reasons were also advanced.

1. The male organ did not have the strength to force the semen into the partly blocked cervical canal.

2. The urethral orifice of the male and the cervical os of the female were not in apposition through the difference in length of the penis and variations in the depth of the vagina. Also the position of the uterus was variable. The uterus is a little lower after each childbirth.

3. As the vagina embraces the penis the aim is disturbed, also the soft parts are likely to deflect the semen.

4. The semen is very tenacious and therefore difficult to force into the cervical os.

Even if the semen entered the uterine cavity, the mucus present would obstruct its passage.

In the light of the state of knowledge of that day, we can readily appreciate these points, even though they are valueless today. At that time it was not known that the uterus at orgasm exerts a sucking action and so draws the semen into the canal from distant parts of the vagina; even when the semen is deposited upon the vulva, fertilization and pregnancy may readily occur. Again the

ciliary action of the ciliated cells of the uterus and oviducts causes a sort of current up the uterus and tube toward the descending ovum, so that usually about one and a half hours after the sperm is deposited in the vagina, it may be found on the ovary; that is because the spermatazoa swim better against the current established by the cilia than with it; in the latter instance they cease moving. In the light of knowledge of today with one fell swoop all these arguments are wiped out.

Still the manner in which they got around these points in Dewees' time is quite ingenious and is also an illustration of interpretation of facts, such as occurs even today.

It was thought at one time that the vagina absorbed the semen and that the latter was carried (1) by the blood current to the ovary and (2) absorbed by a special set of vessels called "seminal absorbents" that had direct communication with the ovaries.

1. This first theory was denied, as by that method the spermatozoa would become too alterated by the blood to be able to impregnate the ovum.

2. The second theory was believed and at this time they thought they had the proof of the absorbent vessels. It was just at the period that Gaertner discovered the remains of the ducts of the mesonephros (wolffian ducts) in the female. Ordinarily they atrophy and disappear, but at times they persist either in part or *in toto* and constitute the ducts of Gaertner. When the latter discovered these remains at the vulvovaginal region, he was sure he had discovered the seminal absorbents. It was so hailed and it was thought they extended directly to the ovary. One cannot blame them nor find fault with their interpretation. We have only to go back a few years and some of us embryologists have had to unlearn and relearn some embryology. Not so many years ago it was thought that the pancreas was derived from a dorsal diverticulum only, and how its duct managed to join with the common bile duct was an explanation both weird and unsatisfying to an analytic mind. Now we know the true facts and yet for the nonce we are no further advanced than in the time of Gaertner.

The argument advanced for the presence of seminal absorbents was both clever and logical to a certain extent. Dewees says that no one has shown the presence of lymphatics in the brain, yet every one admits their presence. No one has ever traced them, yet they are supposed to be present, so he felt they should take for granted the presence of seminal absorbents within the vagina, and some may be just outside the vagina and within the labia. It was supposed that the rugæ of the vagina held the semen in place and assisted it to liquify so as to spread readily over the vagina.

On the other hand if absorbent vessels were present why did they not also take up the gonococcus and lues and carry them to the ovary? Because these vessels were apparently stimulated to absorption only by the semen. To clinch this answer, the lacteals were cited as an example. These took up only food particles and not refuse. They were stimulated by chyle only. It has been proven that male semen alone would influence the ovum so as to produce conception, so that these vessels may respond only to certain stimuli. The question of relative sterility was explained by the answer that the semen of the first husband did not exert the proper influence (open sesame) upon the female seminal absorbent vessels and that of the second did. Yet no doubt these explanations sounded just as plausible as some of our present day theories will at a corresponding period hence.

In order to establish the occurrence of superfœtation, a number of points must be noted.

1. A marked difference in age and size between the two off-spring.

2. If labor occurs at full term for the first off-spring, there will be no lochial discharge and lactation does not begin. However, with the birth of the second off-spring these phenomena will occur.

3. If one is dead at the time of the birth of the other, this should have a fresh and unmacerated appearance showing that its death was recent.

4. Each off-spring has its own placenta usually.

5. There should be no indications of an extra-uterine hæmorrhage separating one placenta and so accounting for a difference in ages due to a retarded development.

6. The second conception retains its attachment to the uterus until after the birth of the older child. The uterus should contract and practically no hæmorrhage follow the first placenta.

Foderé states the following rules:

1. The lochia must remain absent after the birth of the first child.

2. The breasts should contain no milk. There should be no milk fever, although the breasts are well developed.

3. The patient feels movement of the second child soon after delivery of the first.

4. The abdomen remains enlarged and all the signs of a pregnancy should continue and not abate.

5. Skilled experts should readily prove the presence of a second child.

6. At the second birth a lochial discharge should appear, milk should flow, and the mother should feel all the usual sequelæ of an ordinary birth.

7. The second child is always stronger and better developed than the first one.

Some of the reported cases of superfœtation will be given.

Cassan reports the case of a woman who bore a female child of 4 pounds on March 15, 1810; still the uterus remained fairly large and on May 12, 1810, she gave birth to another girl of about 3 pounds. The times of intercourse were definitely given as July 15 and 16, 1809, and September 16, 1809.

Cassan cites Bauhin and Ruysch, who were partisans of superfœtation, and they reported a number of cases of which one was very certain. A woman gave birth to a child of full term and shortly thereafter passed a small fœtus about as long as a finger.

Cassan also cites the case of an Amsterdam surgeon who reported that a woman gave birth to a normal living child and 6 hours later passed a small embryo and placenta of about 3 months' development.

According to Mertens, Maton reported the case of an Italian woman of Palermo, the wife of an Englishman, who gave birth to a boy on November 12, 1807; on February 2, 1808, she gave birth to another healthy and fully developed boy. This was scarcely three calendar months after the first birth.

The *Encyclopédie Médicale*, of February, 1849, gives the following case: A woman who had had six children was pregnant with the seventh and on February 15, 1807, she gave birth to a well developed male child; the placenta came away normally. After birth the abdomen was still enlarged and the movement of a fœtus could be felt. Before the birth the uterus had shown a vertical furrow or groove. On March 15, 1807, she gave birth to a well developed male child.

Mertens also cites A. Duyes who reports the following: A woman aborted at the fifth month. The first fœtus was eight and one half inches long; this was followed by a second that was about three and one-half inches long, indicating about the third month according to him.

Arrowsmith cites Eisenmann's case of Marie Begaud, age 37, who gave birth to a full time boy on April 30, 1848. She had no lochial discharge and no milk. Fifteen minutes later she felt a movement in the womb and on September 16, she gave birth to a full term girl. This time she had a lochial discharge and lactation began. The second appeared four and one half months after the first child.

Desgranges of Lyons wrote of the following case to Foderé: Benoite Villard, age 27, had a miscarriage on May 20, 1779, and a month later was pregnant. On January 20, 1780 (eight months after the former miscarriage and seven months after the second conception) she gave birth to a girl. She had no fever, no milk, and no lochial discharge. The abdomen did not get much smaller, but increased soon thereafter. On July 6, 1780, she gave birth to another girl, 5 months and 16 days after the first birth. This was followed by a lochial discharge and milk. This interval is too long to indicate a protracted pregnancy.

Churchill reports the case of a woman who gave birth to a lively child on April 30, 1818, and on September 17 of the same year (four and one half months later) gave birth to another healthy and mature child. After the birth of the first there was a slight lochial discharge and milk started, but both soon ceased.

Arrowsmith cites another case, reported in the *Gazette médicochururgicale*, of a female of 32 who had never been pregnant and who menstruated regularly to June 15, 1845, and then the menses were suppressed. In August the menses returned twice in a fortnight's interval, so the idea of pregnancy was dismissed. Vomiting and sickness and other signs appeared and on February 28 she gave birth to a full grown male child. Shortly thereafter another fœtus of four and one half to five months of age appeared.

According to the *Lancet*, M. Langmore exhibited to the London Medical Society a supposed twin abortion. The case aborted about May 22, and a fœtus of about 4 months was found. It was flattened, atrophied and apparently had been dead for sometime. This was soon followed by another fœtus and placenta of about 5 to 6 weeks' develop-

ment. The society granted that this was a case of superfœtation.

Herzog reports three cases:

1. Dr. Spaulding delivered a woman on September 1, 1897. The child had been dead sometime and was macerated. A few minutes later another bag (about the size of a fist) with a small placenta at the side, all intact, appeared. The first was a female fœtus of about full term. The second one contained a compressed and macerated fœtus of 64 millimeters length.

2. Dr. Andrew. By abortion a woman passed an ovum of about 16 to 17 millimeters in diameter October 10. Another small and three to four weeks' old fœtus was in the uterus. He stated that the last menstruation had been August 15.

3. Dr. Whalen. The woman had had her regular menstruation up to March 15. On March 20 she had pains and an abortion. Two products of conception. One fœtus 6.2 centimeters in length and an embryo 6.5 millimeters in length.

Bloch on December 14, 1915, delivered a woman of a normal full term male child of 7 pounds. The placenta was soon expelled and this was followed by a second fœtus of about three and one half months of age. This was dead. There was some flattening, but no maceration nor abnormality. The placenta had two cords, that of the living child was attached to the center of the placenta, while that of the dead fœtus was attached to the margin. The placenta was apparently normal. There was one amniotic sac. Some of the members of the society, before whom this was reported, considered it a case of twin pregnancy and others considered it a case of superfœtation.

Gustetter reports a case. M. G. had several normal children and the last one April 10, 1917. She menstruated during the latter part of May for 15 days. In the latter part of July she again menstruated and had severe pains on both sides of the uterus. The next day she ceased to menstruate. After that she soon developed an erratic continuous menstruation and suffered extreme tenderness on external palpation of the uterus. September 16, she had a peculiar sensation in the abdomen for only a short time and then there was no repetition thereof. On September 18, she had more hæmorrhage and on September 21 was delivered of a fœtus of about 4 months of age and which had apparently died on September 16 when she had the peculiar sensation in the abdomen. The placenta was expelled shortly after the fœtus. In the cervix another whitish mass was noted and, upon examination, it proved to be a fœtus of about 50 days' development. Apparently the second fœtus lodged and developed near the margin of the older placenta, and as it grew it became more and more attached to the other placenta, causing hæmorrhage and pain. He believed the abortion was due to the fact that the second implantation was close to first placenta.

Flowers reported a case in which a white woman was delivered of an eight months old white female fœtus and a full time mulatto child.

Franco described a case of a fœtus of 6 months and another smaller one that were aborted at the same time. The smaller was well preserved and the membranes were intact. It was slightly distorted in the lumbar region and seemed 5 to 6 weeks old. Microscopic examination showed a marked necrotic change and Franco decided that it had been carried for 4½ months as a dead body. That seems doubtful to the writer, on grounds which will be advanced later.

A number of cases of superfœtation have been reported in animals. Arrowsmith reports such an instance in a ewe. A ewe 2 years old, produced a lamb on March 2, 1833, which was full term and healthy; on March 30 it had a second one. After the first one the ewe had plenty of milk. The second lamb was perfectly formed and healthy. The ram had been admitted October 8, 1832, and had remained from 4 to 5 weeks. This ewe apparently took the ram early and late. In the fall when the ewe was killed it was found that the uterus was normal. This could not be considered a case of overtime as the extreme limit of overtime in the sheep is said to be 11 days. In the horse and cow the limit is greater.

Jepson reported that in watching a cat give birth to its kittens, he saw one mature kitten followed by a mass the size of a walnut and this a little later was followed by another full time kitten. The small mass proved to be a fœtus about ¾ inch in length. The sac and all seemed in a healthy and normal state, so that it did not appear to be an instance of arrested development.

Harmon reports two cases of possible superfœtation. The first occurred in a cat and the second in a cow.

1. In the case of the cat the older fœtus was near term and the younger was about 7 to 8 weeks developed. Both were in the same state of preservation and the blood vessels seemed to indicate that the difference in size and development was not due to an early death of the smaller fœtus. The smaller cat was near the vagina.

2. The cow was mated December 22, 1916, and then kept by herself and then only for a short time did she run with other cows, but no males. On September 17, she gave birth to a normal heifer a little above average in size. On October 1, she passed a fœtus a little over 4 months old; the amnion and placenta were in a good state of preservation. It apparently had died a short time before abortion.

Hunt reports two unequally developed cats. The cat first gave birth to a small embryo and a few hours later had a normal full term kitten. The smaller measured 14.1 millimeters from crown to rump and probably represented about one seventh of full development, or about 2 weeks stage. Histological examination showed the organs to be clearly outlined, but some nuclear fragmentation was noted. It showed no external changes like maceration and the morphology seemed normal.

Kuntz reports four instances that might be looked upon as superfœtation. One cat uterus contained two full term kittens and two small fœtus, one 10 millimeters and the other a little less, in length. He reports another instance in a cat in which there were four fœtus. The larger two were about 70 millimeters in length and the two smaller ones representing a stage not much later than the closure of their neural tube. On the ground that each ovary contained two well developed corpora lutea of apparently the same age, from a microscopic standpoint, and that the microscopic examination of the fœtus showed marked maceration, he calls them instances of arrested development. The larger fœtus was toward the oviduct.

Another example occurred in a bitch. During an operation it was seen that she was pregnant with 6 fœtus, all in the same state of development, apparently. She recovered and later had her litter. She had four full term, two living and two dead, and one less than full term, but the sixth was unaccounted for. The smaller dead fœtus weighed about 40 per cent of a full term and it had no hair and was not appreciably macerated. Miscroscopic study of the organs showed them to be well preserved, but necrotic. He considered this arrested development also.

Mention has also been made of overtime and it might be well to call attention to another matter at this point, that of rapidity of successions of pregnancies.

Campbell states that he had paid much attention to the protraction of labor and finds that it might be lengthened by a week or a month. In three especial cases the times were 11, 13, and 18 days.

De Granville allows that for a period of 30 days after childbirth the female procreative organs are not capable of exercising their functions. This means that another child could not be formed for at least 304 to 310 days.

Bonnar had collected a number of such cases and found 10 of 300 to 309 days and all these second children were mature and healthy. Of those 290 to 299 days he found two instances and of those 280 to 289 days he found four instances.

In this connection a few questions might relevantly be asked.

1. What is the shortest interval likely to elapse after parturition before impregnation can again take place?

2. At what age of extra-uterine life is it possible for a child to be raised to such a period as to show that it had at least outlived the accidents and liabilities necessarily attendant upon premature birth?

1. Bonner believes that 14 days after delivery is the earliest period at which the uterus can assume its functions.

2. It was formerly believed that a child would live any time after 3 months, but none had the powers of living to manhood or being reared, before the seventh calendar month.

A number of interesting cases are cited.

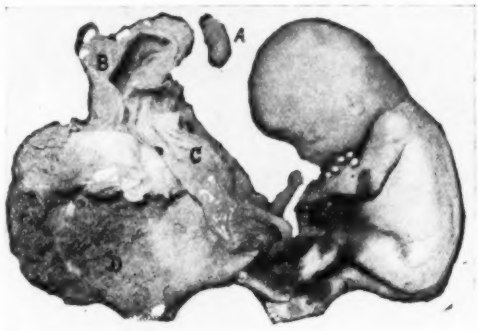

Fig. 1. Photograph showing the relative sizes of the two fœtus. *a*, smaller fœtus; *b*, sac for smaller fœtus; *c*, sac for the larger fœtus; *d*, placenta.

Hon. P. B. born 259 days after his brother and was alive at the age of 76.

T. H. T. P. born 238 days after his sister and lived 2 years.

L. C. H. born 162 days after the brother and lived to be married.

In a table of 105 premature births 69 survived upward of one day to many years. Bonnar also believed that a child ought to be at least 8 days old in order to be pronounced viable.

Brouzet, of Fontainebleau, physician to Louis XVI, cites a case in which a woman gave birth to a second child 6 months after a first one or 159 to 165 days after the first. This may have been a case of superfœtation.

In the family of Baron A. the fourth child was a daughter and the fifth was born 173 days thereafter and survived 28 days. The gestation period would be only about 159 days then.

Lord C. J. G.'s daughter was followed by a son in 127 days (113 actual development). This is 67 days less than the lowest viability period.

According to Bonnar the last three cases are real superfœtation. All the foregoing are authoritative cases from Burke's and Lodge's Peerage.

In Velpeau's *Elements of Midwifery*, he cites the case of Madame Begaud mentioned in the early

Fig. 2. A sketch of the smaller fœtus magnified four times.

part of the paper. Campbell calls it a case of protracted pregnancy and yet in his own work states that the lowest overtime is one month and yet the case above is 53 days overtime. Campbell states that he devoted much attention to this condition and in his chapter on "Duration of Pregnancy" he states the term may be lengthened by a week or a month.

He cites three cases of 11, 13, and 18 days overtime. General modern jurists (in 1835) allowed 293 days as the time of gestation. The Napoleonic Code allowed 300 days and the Prussian law 302 days. Bonnar cites the *American Journal of Medical Sciences* as reporting a case of 317 days. Professor Simpson, in the *Edinburgh Monthly Journal*, July, 1853, cites 4 cases in his experience. Two in exactly 280 and one in 336 days and the other in 319 days. If we allow 23 days as average time between the cessation of one and the beginning of another, then the actual time of the last two would be 313 or 296 respectively, and of the first two 257 days.

Having presented a review of some of the literature upon the question, I will describe the specimen in my case. The report was made to the writer by George F. Spencer who received the specimen in the routine of undergraduate obstetrical work.

The specimen was apparently the product of a spontaneous abortion and appeared in good condition. It had been placed in a weak solution of formalin soon after the delivery so that degeneration and necrotic changes were controlled. It consisted of a larger fœtus of about a 4 months' pregnancy, with umbilical cord and placenta intact. The sac had ruptured so that the fœtus appeared before the placenta and sac. Upon the margin of the placental area of the sac was what appeared to be a cyst, but when this was opened it was found to contain a smaller fœtus of about 18 millimeters length. From examination, the smaller fœtus was found to be of about 38 to 40 days' development. This fœtus was free in the sac, as its umbilical cord had been torn from the body at the abdominal wall, where the ragged scar and the abdominal viscera could be noted. The appearance, however, was such as to lead one to believe that the disconnection was recent as the fœtus did not seem at all macerated, but appeared normal. Both fœtus were photographed and the smaller also sketched at a four times enlargement.

The history is as follows: The abortion occurred on October 12, 1919. The mother was 25 years of age and had been married 2 years and, although nothing had been done to prevent pregnancy, this was the first instance. There is no history of disease in either parent. The last menstruation occurred 3 months and 2 days before the abortion. Following the first period missed, she suspected pregnancy, but had intercourse at intervals up to probably a week before the abortion. There is no history of trauma, fall, or injury of any kind. Recently she had suffered from increased constipation and had taken a heavy dose of castor oil and these are the only contributing factors known.

The larger fœtus is that of a female and measured 11.6 centimeters from crown to coccyx. The lower extremities show several darkened areas under the skin that may be ecchymotic in nature. The external morphology is normal and in no way indicative that the fœtus had been dead very long. The ears are completely formed and normal, the eyelids are firmly united, the lips are slightly parted, but the nostrils are closed with a mucous plug on each side. The extremities are normal in appearance and proportionate in size to the trunk. The nails are also well started. The cloacal area has been completely divided, the anus established and normal, and anal orifice patent. The genitalia are well developed and normal in appearance. According to Mall's method of computation the fœtus is 16 to 17 weeks of age and the general morphology and developmental stages of exposed parts warrant that conclusion also.

The smaller fœtus measured about 18 millimeters in length. The formation of the eyeballs is normal for this length, the pigmentation of the retina being distinctly noticeable and the white patch of the epithelium indicating the formation of the lens, is characteristic.

The nasal pits are indicated as dot-like areas and the upper jaw is still incomplete, while the mandible is complete indicating, from facial development, about the thirty-eighth to the fortieth day. The tuberculum impar portion of the tongue is clearly visible in the small oral cavity. The external

auditory canal portion of the first external brachial pouch is characteristic of this stage. The trunk portion shows the usual development and the near pubic area is the torn edge of the abdominal wall where the umbilical cord has apparently been torn loose. A short tail-like point of the coccygeal region is noticeable. Each limb bud shows a division into two portions, arm (1) and forearm-hand (2) divisions for the pectoral appendage and the thigh (1) and leg-foot (2) divisions for the pelvic appendage. The stage of the limb buds might be considered a few days under 40 days.

There is one combined sac or membrane mass for the two. The umbilical cord is about 19.5 centimeters long and shows only a few twists and knots, but intact throughout; its attachment to the placenta is excentric. The placental portion is 8.5 centimeters in diameter and it measures 1 to 2 centimeters in thickness. At one side is the sac for the second fœtus. This measures about 4 to 4.5 centimeters in diameter and the small umbilical cord has an excentric attachment. This sac is an independent one and by careful manipulation can readily be separated from that of the larger fœtus except at the placental area where the fusion is real and not due to mere pressure, as is indicated on the sac proper. Between the two sacs where they are attached to each other by pressure union, there is a layer of tissue 1 to 2 millimeters in thickness that looks like an early decidual tissue, but in all probability represents a portion of the chorion frondosum and læve of the younger sac compressed against the larger sac as the embryo grew. From its thickness and general state it seems as though it is younger tissue than the larger sac. This layer of tissue is continuous with the placental part of the smaller sac just where this blends with the placenta of the larger sac.

After a careful study of the specimen the writer considers this a case of superfœtation.

The marked difference in sizes and the seemingly excellent state of preservation seem to indicate this, although the smaller fœtus was disconnected through a torn umbilical cord. Even though it may have happened a week before that would account for degenerative changes in the organs, and still there could not be marked maceration of the skin.

The claim of some is that a dead fœtus may be kept *in utero* for a long period and not show an extensive maceration. This may be after the fifth month when the skin glands are preparing the vernix caseosa; that in itself protects the skin from maceration. After that time perhaps the fœtus may be dead for months and not show marked external change, but the writer does not consider that possible in younger fœtus, especially those up to 12 to 16 weeks of age. Development and differentiation have not gone far enough to render the skin self-protecting and consequently the smaller the fœtus the more readily it will macerate and disappear. In the case of the dog in Kuntz's case, he states that 6 fœtus in healthy state were present at the time of operation, only 5 were born and some of these dead. What became of the sixth? No doubt it macerated, distintegrated, being under the protective age, while the others that lived a little longer until they reached that stage and then died, remained *in utero* until term.

Although there is no way of proving the following, yet the writer would like to believe that the smaller sac was toward the opening of the oviduct, that is, represented a product of fertilization that entered the uterus after the older (larger) one. In other words, this smaller fœtus represents an ovum that was fertilized about 9 to 10 weeks after that of the larger fœtus.

The reasons for so believing are: (1) the difference in developmental stages, (2) the fact that unquestionably there were two distinctly separate original sacs, and that this could not be a twin pregnancy with fused sacs, because of the differences in development of the two fœtus and because of the layer of tissue between the apparently fused sacs. This fusion as already pointed out is only apparent and due to the pressure except at the placental area where a real fusion occurred.

Just as positive that some are that superfœtation cannot occur because ovulation ceases during pregnancy, just so positively would the writer like to assert that no young fœtus could exist dead 2 or more months without showing marked signs of decomposition and maceration.

The stand taken that because superfœtation does not occur frequently, is the one reason why it does not occur at all seems puerile. All rules have exceptions, but those exceptions are not common or they would not constitute exceptions. Simply because a thing has not occurred previous to a certain time, does not mean that it can never occur.

How about the flying machine, wireless telegraphy, and wireless telephony? How about transplantation of organs, fruit grafting, etc.? No doubt our predecessors said it could not be done, but it has been done.

Again to state that ovulation ceases invariably during pregnancy is also wrong. It has been proven to occur in lower animals and in human females. As an exception to the general rule why should not a corpus luteum of pregnancy undergo early involution and and thereby remove the inhibition of its internal secretion and permit another follicle to mature and rupture one, two, or three months later? If this has occurred why should there not in these early months be still space enough for spermatozoa to work their way up into the oviduct and fertilize such an ovum?

Again sperm may live for one month in the female genital tract, and perhaps longer, and some believe the viability of the ovum to be greater than one week. In the hen the sperm may live for 35 days. With these facts in mind, if spermatozoa have waited for a month, or more, in the oviduct and entered it only one month after the first fertilization, that would make a difference of two months in the two products of conception. Again if the spermatozoa entered 8 weeks after the fertilization, the writer still believes (as others who are not believers in superfœtation also admit) that spermatozoa could still get up into the oviduct in some cases and by waiting another month fertilize an ovum and make a three months difference in the two products of conception.

Of course, superfœtation is rare. It cannot occur frequently as all the factors in favor of it must exist at the same time, a chance in a thousand or in a million, but we must never forget that the millionth chance does exist and will come to pass at some time. After a three-months interval, the occurrence of superfœtation is quite doubtful.

This case, in the writer's opinion, indicates a superfœtation in which the difference between the two fœtus represents about 2½ lunar months, also that the second product entered the uterus, made a complete placental fusion, but only an apparent fusion of the sacs.

In conclusion the writer desires to thank Dr. Spencer for the opportunity of presenting this specimen and Dr. J. Parsons Schaeffer for his suggestions.

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DEPARTMENT OF TECHNIQUE

BREAST INFECTIONS[1]

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THE pandemic of influenza which made its appearance in the fall of 1918 and again in the winter of 1919–20, left in its trail a lowered resistance to the pus-forming organisms. This fact has been noted by so many observers in such widely variant specialties that we believe it may be stated without the fear of contradiction.

Breast infections in the Michael Reese Maternity showed a distinct increase in such direct chronological sequence to these waves of influenza that it was thought desirable to utilize this situation in two directions: first, to obtain confirmation from other maternity clinics throughout America of the etiological explanation mentioned above, and second, to make an analysis of the technique of breast care in these clinics both in the normal breast and in the various types of infection in order to arrive, if possible, at a procedure that seemed best calculated to prevent suppuration.

To this end interrogatories were sent throughout the country to maternity clinics the hospital data of which, as furnished by the editor of the *Journal of the American Medical Association*, seemed to indicate that their services were sufficiently large to enable them to reach conclusions based on a sufficient number of cases. Answers have been obtained from practically all the institutions so addressed, many of the answers entailing considerable work on the part of the contributors. The writers desire to express their indebtedness and appreciation of these efforts and hope that the data here presented may, in a measure, compensate them.

In the Michael Reese Maternity during the period between January 1, 1917, and October 1, 1918, *i.e.*, the pre-influenzal period of 21 months, there were 1,555 service cases with 4 cases of breast abscesses (0.26 per cent), 528 staff private cases with no cases of breast abscesses, and 240 outside private cases with one case of breast abscess (0.42 per cent), a total of 2,323 cases with 5 cases of breast abscesses (0.23 per cent).

During the period between October 1, 1918, and December 1, 1919, there were 702 service cases with 5 cases of breast abscesses (0.71 per cent), 363 staff private cases with 9 cases of breast abscesses (2.48 per cent), and 147 outside private cases with 3 cases of breast abscesses (2.04 per cent), a total of 1,212 cases with 17 cases of breast abscesses (1.74 per cent).

Among the 17 cases of breast abscesses quoted above, 4 had had influenza of varying degrees of severity while pregnant, 2 had had a "severe cold," in another case the husband had had influenza during the pregnancy of the wife, and 6 gave a negative history of "cold" or influenza themselves or in the household during the period of pregnancy. The remaining 5 could not be traced.

In the interrogatory two questions bore on this point. Answering the first question "Have you noticed an increase in the percentage of breast abscesses since the influenza epidemic of last fall and to what extent?" among 29 clinics, 2 answered "nearly double," and "apparently so." The remainder answered either "no" or left the question unanswered. Answering the second question "Has this increase, if any, been chiefly or entirely among patients who had influenza during their pregnancy?" 14 failed to reply, 9 said "no" and noted "no relationship."

We believe that these negative answers would, in many instances, have been positive, had the possibility of such a relationship been called to the attention of the profession early in the epidemics.

The Michael Reese Maternity has a definite routine for the care of the breasts and this is adhered to in all service cases and in the staff private cases. Physicians in charge of private outside cases usually follow this routine but vary it at will. An analysis of the technique of the Michael Reese Maternity is here presented in conformity with the 18 questions of the interrogatory, followed by the replies of the 29 clinics to the same questions, classified on a percentage basis, the answer which has been subscribed to by the greatest number being given first in each instance:

[1]Read before the Chicago Gynecological Society, November 19, 1921. (For discussion see p. 376.)

	1. Do you have a prenatal clinic?	2. What attention is paid to the care of the nipples and the breasts during pregnancy?	3. What treatment, if any, do nipples and breasts receive on patients' admission when in labor?	4. Do you use breast binders? If so, what kind?	5. What special protection, if any, do the nipples have under the binders?	6. What attention, if any, is given the nipples before and after each nursing?	7. Do you make an attempt to cleanse the mouths of the babies before and after each nursing?	8. HOW DO YOU TREAT—			
								a. Painful nipples?	b. Fissured nipples?	c. Bleeding nipples?	d. Retracted nipples?
1	Yes	Cleanliness with boric wash	Cleanliness	Only to prevent secretion	None	Boric acid wash	Sponge with boric acid solution	Cleanliness and nipple shield	No routine	No routine	Manipulation
2	Yes	Wash twice daily with boric and alcohol if sore	None	Vest-shaped binder if sore or pendulous or painful	None	Boric acid wash	Sponge with boric acid solution	Nipple shield, glycerite of Tannic acid, comp. tinct. of benzoin or 25 per cent balsam of Peru after nursing			Pt. pulls them out in pregnancy or nipple shield
3	Yes	Astringent lotion or softening cream	Soap, water, acid boric and sterile pad held on by binder during labor	Brassiere or Richardson type as needed	Sterile gauze	Boric acid	None	None	We use a nipple shield for all types—also $AgNO_3$ or tinct. benzoin comp. others as indicated—no routine—no nursing if nipples are badly retracted		
4	Yes	Castile soap and nail brush. Cocoa butter if sore	Soap and water and nail brush	Many-tailed binder for engorgement or pain only	Sterile gauze	Boric acid with sterile cotton	Boric acid	Ice cold pack	10 per cent $AgNO_3$ comp. tinct. benzoin and shield	Cold + glass nipple shield	Massage + breast pump
5	Yes	Daily massage followed by boric wash	None	No	None	Boric acid	Boric acid	None	Nipple shield	Nipple shield	Gentle traction 4 times daily
6	Yes	Olive oil twice daily	None	Muslin binder shaped to body	Sterile cotton and sweet oil	Boric acid before and after	Boric acid	None	Nipple shield + $AgNO_3$ stick—no nursing		Pump 2 times daily in last month
7	No	Soap and water	None	Shoulder strap type	None	Boric acid	None	Comp. tinct. of benzoin	10 per cent silver nitrate + sterile dressings		Breast shield
8	No	Massage out only if depressed	None	Support only if heavy	Sterile gauze	Boric acid	Boric acid	Nothing but shield	Boric acid, bismuth and vaseline, nipple shield		Massage and shield
9	Yes	Olive oil, glycerine and support if necessary	None; 1:4,000 bichloride after delivery	Unbleached muslin	Boric	Boric acid and olive oil	Boric acid	Nipple shield and olive oil	Nipple shield, olive oil and bismuth paste		Shield or artificial feeding
10	Yes	Daily massage with vaseline or lanolin for last 3 months	None	Simple support if heavy – no binders	None	Boric acid before and after	None except boric once daily	Massage with olive oil or lanolin	$AgNO_3$ after nursing	Nipple shield and olive oil	Massage with lanolin and nipple shield
11	Yes	Constant attention and instruction to women	Sterile dressings	Yes	Sterile dressings	Boric acid	Boric acid once daily	Soothing applications	Argyrol or $AgNO_3$	As indicated	Try to develop nipples
12	Yes	Bathe often	Bath	Y binder is routine, Murphy binder if not nursing	Clean towel	Boric acid	Boric acid once daily	Nipple shield	Silver nitrate stick or a 10 per cent solution		Draw out by means of a nipple shield
13	Yes	Hygienic	After delivery scrub with water, boric, 50 per cent vaseline and sterile pad	Richardson Y binder	Sterile breast compress	Boric acid and sterile vaseline	None	Boric acid and vaseline and 50 per cent vaseline before nursing—comp. tinct. of benzoin after—also nipple shield			Nipple shield or breast pump
14	Yes	None; patients too ignorant, or albolene for last 8 weeks	None	Breast sling but no binder	Sterile gauze	Boric acid	None	Proper nursing schedule, nipple shield and cleanliness			Prenatal pulling for 4 months
15	Yes	Cleanliness	After labor, wash with green soap and boric and unguentum lanolin and vaseline	If necessary, a Y binder for support	Lanolin and vaseline ointment	Boric acid and vaseline and lanolin ointment	None	Lanolin and vaseline ointment	Comp. tinct. benzoin, $AgNO_3$ stick, or castor oil and bismuth paste	Nipple shield	Nipple shield

16	Yes	Last 6 weeks use soap, water and peroxide, dry and massage outward with vaseline	None	Binder only if breasts are heavy or pendulous	Cleansed with sterile water	Sterile gauze	None	Glass nipple shield, comp. tinct. benzoin, zinc oxide ointment, and sterile gauze			Hard problem; we use wood nipple shield
17	Yes	Support – Wash nipples with 50 per cent alcohol and bland ointment daily	None	Breast binder of unbleached muslin with shoulder strap	Wansboro Pb nipple shield or gauze and adhesive	Nipples washed before and after with boric	Before and after with boric acid or 2 per cent potassium chlorate	Lead nipple shield	Comp. tinct. benzoin, "Plantago" and boric acid on gauze or if bad, use $AgNO_3$ 10 per cent		Begin with nipple shield; nothing if very bad
18	Yes	Soap and water and draw out nipples 5 to 15 times daily; 50 per cent alcohol twice a week	Cleanliness, castile soap and water	Only for special indications	Sterile dry gauze	Cleansed with boric after each nursing	Only once a day	Cleanliness and lead nipple shield			Same with long nursing periods
19	Yes	Bathing with boric acid solution	Cleanliness	None		Boric acid solution		Dressing of boric acid solution or comp. tinct. of benzoin			Traction by nurse or Dr.
20	Yes	None	Soap and water and boric acid postpartum	Yes—jacket	Sterile pad	Wiped with boric acid solution	Swabbed once daily with boric acid solution	Shield (?)	Comp. tinct. of benzoin, alcohol compresses or silver nipple shield		Nipple shield
21	No	Washed with soap and nipples touched with albolene	None	Strong muslin made to fit—pinned down in front and over shoulders	Covered with sterile gauze	Washed with boric acid before and after nursing	None	Use nipple shield	20 per cent $AgNO_3$ with toothpick swab	Have had none	Sponge with cold water, hold out for 5 minutes, 4 times daily
22	Yes	Directed to bathe frequently	None except general bath	No	None	Alcohol and boric before and after nursing	No! Too many parasitic thrush-like growths before we stopped	Witch-hazel or 50 per cent alcohol compress	Balsam of Peru, comp. tinct. of benzoin, shield p.r.n. glycerite of tannin	No nursing till relieved then with shield	Pull during pregnancy, then use nipple shield
23	Not Yet	None	Wash with soap and water, rinse, keep dry and sterile	Unbleached muslin fitted over the shoulders	Dry sterile gauze	Soap and water and rinse with sterile hands	No — face and lips are cleansed with sterile water — O in the mouth	Seldom treated	Clean them and no nursing for 24 hrs. Use pump and later a nipple shield		Mechanical suction for retraction
24	No	None if normal	Yes—Roller	Yes—Roller	Wash and dry, and sterile gauze	Wash and dry and boric acid	None	Nipple shield	Nipple shield and boric acid	No nursing; use pump and boric	Vacuum
25	Yes	Careful cleansing twice daily with 50 per cent glycerol of tannin in water	None except as indication arises	Yes — Murphy breast binder	Gauze dressing over nipples	Wiped off with boric pad before and after	Always before and after with boric acid	Shield and sedative and wean if necessary	Shield and equal parts of castor oil and $Bi(NO_3)_3$	Silver nitrate and shield if necessary	Breast pump, nipple shield, wean if necessary
26	50% seen before	Scrub daily with increasing vigor	None	Plain binder for support if necessary	Sterile gauze	Nipples washed before and after	None	Use nipple shield and pump enough for baby or rest the nipple. Comp. tinct. benzoin or castor oil and bismuth			
27	Yes	Particular care-alcoholic solution for nipples — massage p.r.n.	None but cleansing	Yes — shoulder and breast	Covered with sterile gauze	Yes — ½ saturated solution of boric	Yes — ½ saturated solution of boric acid	Ointments based on comp. tinct. of benzoin and nipple shields			Breast pump
28	No	Only private cases — alcoholic wash or fatty substance	None	Plain strip of cloth for support only	Gauze and binder —cold cream	Boric acid before and after nursing	Wash once daily without regard to nursing	None	Shield and comp. tinct. of benzoin or Bi and castor oil	Breast pump and no nipple shield	Support and ice massage and pump p.r.n.
29	Yes	Cleanliness	Cleansed with green soap and water	Murphy breast binder	Sterile gauze and Pb shield	Boric acid	None	Glass nipple shield	5 per cent $AgNO_3$ or comp. tinct. of benzoin	Stop nursing pump milk and lead shield	Lead shield and breast pump

	9. Have you a special procedure at the time of the incoming of the milk, for the control of breast congestion and the pain?	10. How do you treat a lump in the breast in the absence of fever?	11. What do you do if patient has a chill, fever, a painful spot and leucocytosis?	12. What has been your percentage of breast abscesses occuring in the maternity or shortly after leaving?	13. Have you noticed an increase in percent'e of breast abscesses, since the influenza epidemic which began in Sept. 1918, and to what extent?	14. Has increase, if any, been chiefly or entirely, among patients who had influenza during their pregnancy?	15. Have you noticed a lower leucocytosis in the past year in the mastitis, suppurative and non-suppurative?	16. What organisms have you found to predominate?	17. What is your usual surgical procedure in the presence of abscess?	(a) 8. How do you suppress breast function in cases of a still-birth? (b) Death or removal of baby after nursing has been well established?
1	No routine — binder—ice-cap	Gentle massage or binder	None occurred	Have had none						Snug binder and belladonna plaster; empty if necessary
2	None	None unless tumor or infection is present	Ice and incision and drainage	1.13	No		No	Staphylococcus	Drainage	Binder, saline cathartics and ice-bag
3	No — careful use of breast binders and hot and cold applications	Strap firmly with adhesive plaster	Binder and ice and adhesive	1.5—1913 3.0—1919	Double	??	??	??	Free incision	Binder for 10 days; watch bowels and diet
4	Single binder, no fluids and emprin or codeine	Absolute rest of breast and heat or cold	Remove baby and binder and ice-bag	0.00 in hospital 1918 0.5 after 1919	No	No	Yes	Staphylococcus Streptococcus	Free incision and drainage under gas	Breast binder, ice-bag, no liquids, codeine
5	None	None	Ice locally and no nursing	1.0	Yes 4 times	No	No	Staphylococcus	Incision and drainage	Do nothing—allow secretions to dry up, codeine for pain
6	Saline cathartic 36 hours postpartum	Compresses of hot sterile water	Remove baby, pump and heat and cathartic	Less than 0.25	No	No	No	Staphylococcus	Through and through with rubber tubes	
7	No routine but binder and ice-bag	No routine		Have had none	No	No	No		Incision and drainage and wet dressings	$MgSO_4$ q. a.m. tight binder and express milk
8	No routine Use heat	Leave it alone	No routine	Less than 1.0	No		No		As surgeon directs	Binder, saline cathartic
9	Binder and restrict fluids	Massage and ice-cap	Ice — drain if necessary	0.41	No	No	No	Staphylococcus	Free drainage	No special prescription in some, support or Bier's congestion
10	Ice-caps	Ice-caps	Ice to breast — heat to body	Very small — 2 cases last year	No	?	No cases	??	Radiating incisions and drainage	Compression breast binder and massage
11	$MgSO_4$ at end of 24 hours and restrict fluid	Antiphlogistine, ichthyol, ice, and support	Ice-caps	Less than 1.0—3-4 per year	We are getting less			Staphylococcus aureus in all	Crucial incision and free drainage	Leave breasts alone — ice and morphine
12	Free cathartics and restriction of fluids and ice		Same	About 1%	No	No	No	Staphylococcus	Transfer to gynecologist for treatment	Diet, compression and medication — empty p.r.n.
13	Binder and ice	Ice constantly and stop nursing	Same	0.04; 0.08 need ice-bags	No		No		We refer all cases to surgical department	Free catharsis, restriction of fluids, Murphy binder, no compression and hands off
14	Support and morphine if necessary	Let it alone aside from support	Same	1.33	No	No	No	Staphylococcus	Free incision and gauze packing for 3-4 days	Binder for comfort, ice and catharsis if necessary
15	No	Empty by nursing baby twice on same side and ice-bag for pain	Support and ice	Have gone 2 years without any	No		No	Usually staphylococcus aureus	Wide incision and drainage and Dakin's solution	Sling and morphine

16	Aspirin grs. X q. 4 hrs. codeine p.r.n. and if heavy, support	Empty by nursing and ice-bag	Stop nursing — ice-bag $MgSO_4$ and binder	0 in last 4 years—over 4,000 cases	No	No			Open and drain at lowest possible point	Binder, restrict fluids and $MgSO_4$
17	Hot camphorated oil massage through flannel and no fluids and $MgSO_4$	Same	Empty by nursing and binder	0.4 in hospital; 1.2 after leaving first two weeks	No	No	No	Cannot make positive statement	Incision and drainage	Leave alone except for binder and sedatives
18	Draw out with sterile gloves and suction	Empty by nursing — breasts are to be used	Ice and $MgSO_4$ and tinct. phytolacca	0.00 in last 1,000 cases; 0.2 after leaving	No	No	Yes	Staphylococcus	Wide radiating incision	Binder and $MgSO_4$ and restrict fluids
19	No	Empty breasts by pumping	Empty by nursing and no fluids	0.15—1918 0.52—1919	No	No	No	Staphylococcus and streptococcus	Incision and drainage	Binder, ice-bag, saline cathartic
20	No—restrict fluids	Ice-bag	Same and ice-bags	0.16	No	No	No		Open and drain	Limit fluids and purge
21	$MgSO_4$ every other morning and tight binder	Massage	Ice-bag and rest for breast	Practically nil	No		No		Radial incision and drainage	Binder and ice-bag, and catharsis and restrict fluids
22	Nothing, except increase the nursing interval	Hot wet compress q. 3 hours for 15 minutes and nurse or pump—ice-bag between times	Same, incision if fluctuating	0.8	No		No	Mixed streptococcus and staphylococcus	Incision and Carrel-Dakin method	$MgSO_4$, no fluids and binder
23	Snug binding and occasionally a coal-tar for analgesic	Expectant if local condition does not contraindicate	Binder, catharsis, hot stupes	None					Generously free radial incisions	Snug padded binder, restriction of fluids, catharsis, no pumping or manipulation
24	Restrict fluid and pump	Suspend nursing and pump	Suspend nursing	None	No				Incise and drain	Camphor and pressure
25	Saline purge, binder and massage if necessary	Same with hot fomentations	Pump if no abscess	None	No	No	No	Various kinds of staphylococcus	Radial incision and adequate drainage	Tight binder, saline cathartic, pump and massage
26	Soften by massage after nursing if necessary	Careful massage after nursing	Ice—no massage	About 1	No	No	No	Staphylococcus	Free drainage	Binder and morphine
27	Hot compresses	Hot compresses and massage p.r.n.	Hyperæmia or incision	The larger percentage after	No	No	No	Staphylococcus	Wide incision	Support and restrict fluids
28		Gentle massage	Ice, pump, support—no massage	Less than 1 per cent	No	No	No blood counts	Staphylococcus	Incision and drainage	Restrict fluid, tight binder, ice, narcotics
29	Support breast and use ice-cap	Light massage and ice-cap	Laxative, restrict fluids, ice-cap	1916–0.6 1917–0.5 1918–0.1 1919–0.3	No	No				Ice-cap and support

1. Do you have a prenatal clinic?

Michael Reese Hospital: Yes.

Other clinics: 78 per cent have, 22 per cent do not have prenatal clinics.

2. What attention is paid to the care of the nipples and the breasts during pregnancy?

Michael Reese Hospital: Routine examination of breasts and nipples at the first registration of pregnant woman, instructions as to soap and water, cleansing of nipples, traction and massage for retracted nipples, and mechanical toughening as a routine.

Other clinics: 28 per cent use simple cleanliness; 24 per cent use oil or other fatty substances; 17 per cent use alcohol and cleanliness; 17 per cent have no care of nipples or breasts during pregnancy; 14 per cent use boric acid solution.

3. What treatment, if any, do nipples and breasts receive on patient's admission when in labor?

Michael Reese Hospital: Scrubbed with soap and water, rinsed, bathed with 1:6000 bichloride of mercury, and clean maternity gown put on.

Other clinics: 41 per cent have no treatment on admission; 17 per cent use soap and water; 14 per cent use soap and water and boric acid solution; 12 per cent use soap and water and boric acid postpartum; 12 per cent use sterile gauze; 4 per cent use 1:4000 bichloride solution postpartum.

4. Do you use breast binders? If so, what kind?

Michael Reese Hospital: Yes, fitted breast binders with shoulder straps.

Other clinics: 28 per cent use no binder; 28 per cent use binder only for special indications; 17 per cent use vest or shoulder strap type; 14 per cent use Richardson type; 7 per cent use Murphy binder; 3 per cent use many tailed binder; 3 per cent unbleached muslin shaped to body.

5. What special protection, if any, do the nipples have under the binders?

Michael Reese Hospital: Square of sterile linen over the nipples.

Other clinics: 62 per cent use sterile gauze or cloth; 22 per cent have no protection for nipples; 8 per cent use oil or ointment and sterile gauze; 8 per cent use nipple shields.

6. What attention, if any, is given the nipples before and after each nursing?

Michael Reese Hospital: Swabbed with 2 per cent boric acid solution before and after each nursing.

Other clinics: 83 per cent use boric solution on nipples before and after nursing; 10 per cent use boric solution and oil; 6 per cent wash with water.

7. Do you make an attempt to cleanse the mouths of the babies before and after each nursing?

Michael Reese Hospital: No.

Other clinics: 45 per cent do not cleanse babies' mouths; 41 per cent use boric acid; 14 per cent use boric acid only once daily.

8, a. How do you treat painful nipples?

Michael Reese Hospital: Tea strainer open-air treatment —glass nursing shield.

Other clinics: 21 per cent use nothing; 28 per cent nipple shield (glass) only; 21 per cent, nipple shield and compound tincture of benzoin, or vaseline, or silver nitrate solution; 10 per cent. bland ointments only; 10 per cent, ointments only; 6 per cent, only compound tincture of benzoin; 4 per cent, sedatives only.

8, b. How do you treat fissured nipples?

Michael Reese Hospital: 10 per cent silver nitrate solution; tea strainer open-air treatment.

Other clinics: 60 per cent use nipple shield and compound tincture of benzoin, balsam of Peru, or alcohol; 10 per cent, argyrol or silver nitrate; 10 per cent, boric acid or bismuth and castor oil; 7 per cent, nipple shield and cleanliness; 7 per cent, nipple shield and cleanliness and silver nitrate; 3 per cent stop nursing; 3 per cent do nothing.

8, c. How do you treat bleeding nipples?

Michael Reese Hospital: Compound tincture benzoin.

Other clinics: 40 per cent use nipple shield and balsam of Peru or compound tincture of benzoin; 13 per cent stop nursing; 10 per cent have no routine; 10 per cent use bismuth or boric acid in castor oil; 10 per cent use silver nitrate and stop nursing; 10 per cent use silver nitrate and nipple shield; 7 per cent, use the glass nipple shield and cleanliness.

8, d How do you treat retracted nipples?

Michael Reese Hospital: Glass nursing shield, breast pump.

Other clinics: 26 per cent use manipulation and massage for retracted nipples; 26 per cent combine massage and manipulation with the breast pump; 20 per cent use nipple shield; 14 per cent use manipulation or massage and nipple shield and breast pump; 7 per cent use manipulation and nipple shield; 7 per cent use nothing.

9. Have you a special procedure at the time of the incoming of the milk, for the control of the breast congestion and the pain?

Michael Reese Hospital: Restriction of fluids, ice-bag, purge for undue congestion.

Other clinics: 30 per cent use nothing for breast congestion and pain; 17 per cent use binder and ice-bag; 12 per cent use catharsis; 12 per cent use binder and restricted fluids; 10 per cent use catharsis and restricted fluids; 10 per cent use binder; 3 per cent use heat; 3 per cent use massage; 3 per cent use breast pump; 3 per cent use breast pump and restricted fluids.

10. How do you treat a lump in the breast in the absence of fever?

Michael Reese Hospital: Apply baby to nipple varying its position to change its grasp of the nipple, occasionally peripheral massage directed toward the axilla.

Other clinics: 27 per cent do nothing for lump in breast in the absence of fever; 24 per cent continue nursing and apply ice-bag; 12 per cent use massage and binder; 10 per cent rest breast and apply ice; 7 per cent use massage and heat; 7 per cent use catharsis and ice-bags; 3 per cent pump the breasts; 3 per cent use antiphlogistine.

11. What do you do if a patient has a chill, fever, a painful spot, and leucocytosis?

Michael Reese Hospital: Stop nursing, empty *both* breasts and bind, moisten affected breast with bichloride of mercury 1:6000, apply continuous ice-bag, restrict fluids and purge. Binder is not removed until temperature is normal for 24 hours (at which time baby is again allowed to nurse) or until abscess is inevitable.

Other clinics: 27 per cent use ice-bag and binder and incision and drainage if necessary; 24 per cent use ice-bag and binder, and stop all nursing; 10 per cent stop nursing, use breast pump and catharsis and heat; 10 per cent use ice only; 7 per cent continue nursing and give catharsis and restricted fluids.

12. What has been your percentage of breast abscesses occurring in the maternity or shortly after leaving?

Michael Reese Hospital: January 1, 1917, to October 1, 1918: Service cases 0.26 per cent; staff private, none; outside private, 0.42 per cent; average, 0.23 per cent. October 1, 1918, to December 1, 1919, service cases, 0.71 per cent; staff private, 2.48 per cent; outside private, 2.04 per cent; average, 1.74 per cent.

Other clinics: 24 per cent reported no breast abscesses; 76 per cent reported an average of 0.79 per cent while in the hospital and 0.63 per cent soon after leaving.

13. Have you noticed increase in the percentage of breast abscesses since the influenza epidemic which began in September, 1918, and to what extent?

Michael Reese Hospital: Yes, in all classes of cases. The increase in service cases was 0.45 per cent, in staff private cases 2.48 per cent, and in outside private cases 1.62 per cent, making a total average of 1.51 per cent increase.

Other clinics: 94 per cent have noticed no increase since the influenza epidemic; 3 per cent have doubled the number of cases; 3 per cent noticed an increase.

14. Has this increase, if any, been chiefly or entirely among patients who had influenza during their pregnancy?

Michael Reese Hospital: Yes, four had influenza during their pregnancy, two suffered with bad "colds" and one was living with her husband while he was suffering with influenza, making a total of 7 cases. Six gave a negative history as to the influenza and 5 could not be located.

Other clinics: 100 per cent noticed no relationship to influenza; of these 48 per cent failed to answer this question; 28 per cent said "no," and 24 per cent noticed "no relationship."

15. Have you noticed a lower leucocytosis in the past year, in the mastitis cases, suppurative and non-suppurative?

Michael Reese Hospital: No.

Other clinics: 97 per cent noticed no drop in leucocyte count; 3 per cent noticed a drop.

16. What organisms have you found to predominate?

Michael Reese Hospital: Staphylococcus aureus and albus.

Other clinics: 43 per cent do not report type of organism; 37 per cent report staphylococcus only; 20 per cent report staphylococcus and streptococcus.

17. What is your usual surgical procedure in the presence of abscess?

Michael Reese Hospital: Radial incision, daily gauze packing until red granulations appear, then compression sponge.

Other clinics: 83 per cent use free incision and drainage as treatment of breast abscesses; 14 per cent "transfer to surgical department"; 3 per cent, no report.

18, a. How do you suppress breast function in cases of stillbirths?

Michael Reese Hospital: Breast binder, restriction of fluids, purge.

Other clinics: 54 per cent use binder, catharsis, ice, and restrict fluids; 24 per cent, binder only; 12 per cent, binder and catharsis; 7 per cent, nothing; 3 per cent, camphor and pressure.

18, b. How do you suppress breast function in case of death or removal of baby after nursing has been well established?

Michael Reese Hospital: Same as above, but first empty breasts and pump if necessary.

Other clinics: 54 per cent use binder, catharsis, ice, and restrict fluids; 18 per cent use binder; 14 per cent use binder and sedative; 7 per cent use nothing; 7 per cent use binder and camphor.

It will be seen from a study of the answers which have been received from the various clinics that certain routine procedures have won almost universal recognition, such as the establishment of a prenatal clinic, specific attention to nipples in clinic, some type of breast binder or support, a sterile protective covering for the nipple, boric acid cleansing of nipples before and after nursing, and lastly, in the presence of suppuration, free incision and drainage.

The greatest diversity of opinion is found in those conditions in which prophylactic treatment is most imperative, *i.e.*, the treatment of pathologic nipples, of breast congestions, lymphangitides, and threatened abscesses. Possibly a study of the table appended will serve to unify the kind of treatment in a particular condition.

It will be noted in the table that clinics 15 and 25 reported no breast abscesses yet gave predominating types of organisms found.

Clinics 4 and 19, show a decided increase in breast abscesses in the maternity or shortly after leaving as before 1918 and 1919, yet answer "no" to question "Have you noticed an increase in breast abscesses since the influenza epidemic which began in September, 1919?"

Clinic 4, answering question "Has there been an increase in breast abscesses among influenza patients?" states "no," yet answers "yes" to question "Has there been a lower leucocytosis noted in breast abscesses occurring during the influenza period?"

One of the writers and a staff colleague have each had the experience while visiting maternity clinics elsewhere of being assured in good faith that they have no breast abscesses, and then inadvertently stumbling on an actual case.

There seems to be a tendency to gloss over such cases, apparently because of an implied guilty responsibility. We have no such reluctance for we know the care with which our technique is conducted and controlled and we recognize the hæmatogenous and lymphatic origin of abscess to be very real. Among the details of technique may be mentioned throat and nasal cultures on each pupil nurse or interne just before coming on the maternity floor; removal from the floor, of interne, nurse, maid, or workman found to have suppuration; treatment of minor infections of patients, *i.e.*, paronychia, etc., by interne from gynecological service, etc.

SUMMARY

The influenza epidemics of 1918–1919 were largely responsible for the increase in breast infections following them, in the Michael Reese Maternity.

The technique employed in the Michael Reese Maternity conforms closely to that used in most of the clinics analyzed. These procedures were not varied during the periods of increased incidence of infection. This tends to confirm our view that the increase was in relation to the influenza waves.

We believe it would be advantageous for the largest possible number of clinics to adopt a uni-

form procedure for the prophylactic treatment of pathological nipples, breast lymphangitis, and threatened abscess, preferably that favored by the largest group in each case.

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PERINEORRHAPHY FOR COMPLETE LACERATION[1]

BY THOMAS J. WATKINS, M.D., F.A.C.S., CHICAGO

IN this paper I will attempt to review some important developments in the treatment of complete laceration of the perineum and will endeavor to demonstrate that perineorrhaphy for complete laceration has been perfected to the extent that a satisfactory result is almost certain to be obtained, that the technique is relatively simple, and that the patient should suffer very little distress after operation.

J. Collins Warren published a description of "a flap" operation for complete tear of the perineum in the *Boston Medical Journal*, in 1875. He later described this operation in a paper presented before the American Gynecological Society in 1882[2]. Figure 1 illustrates his method of forming the flap and Figure 2, his method of suture. He disposed of the flap by doubling it upon itself and reported satisfactory results. The special advantages gained were that the rectal mucosa was eliminated from the field of operation and the danger of a rectovaginal fistula occurring was lessened.

George Noble[3] in 1902 described an operation which displaced the upper part of the tear to the level of the skin and thus made the occurrence of a rectovaginal fistula following operation impossible. This was accomplished by separating

[2] Tr. Am. Gynec. Soc., 1882, vii, 322.

[3] Ibid., 1902.

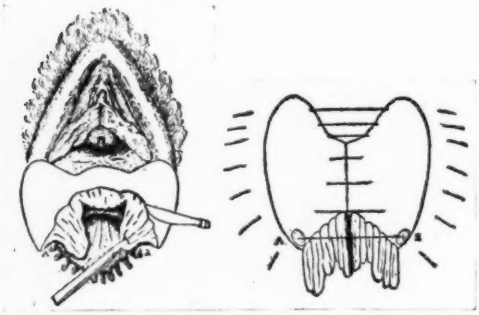


Fig. 1*. Collins' method of forming flap.
Fig. 2*. Collins' method of suturing flap.

* From Transactions American Gynecological Society.

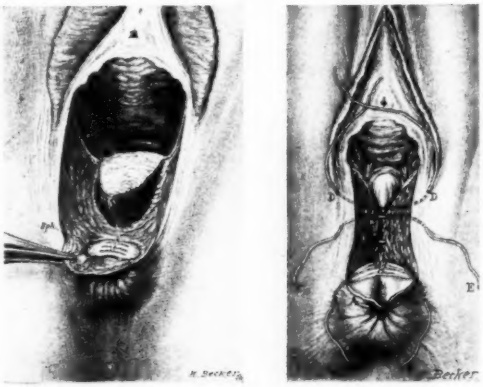


Fig. 3. The torn ends of the sphincter are freed and united by suture. (Kelly.)
Fig. 4. The flap is turned downward over the anus and the wound is partly closed. (Kelly.)

[1] Read before the Chicago Gyneecological Society November 19, 1920. For discussion see p. 379.)

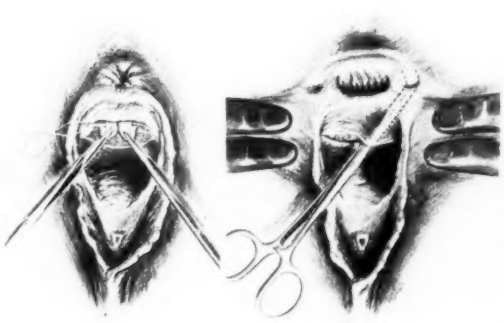


Fig. 5. Fig. 6.

Fig. 5. A transverse incision is made through the vaginal wall some distance above the tear. The torn ends of the muscle are exposed by blunt dissection with the scissors.

Fig. 6. All the tissue between the torn ends of the muscle is separated by blunt dissection down to the rectal mucosa.

Fig. 7. Fig. 8.

Fig. 7. The torn ends of the muscle is grasped on either side with an Allis forceps and elevated into the wound.

Fig. 8. Individual suture of the sphincter muscle is made.

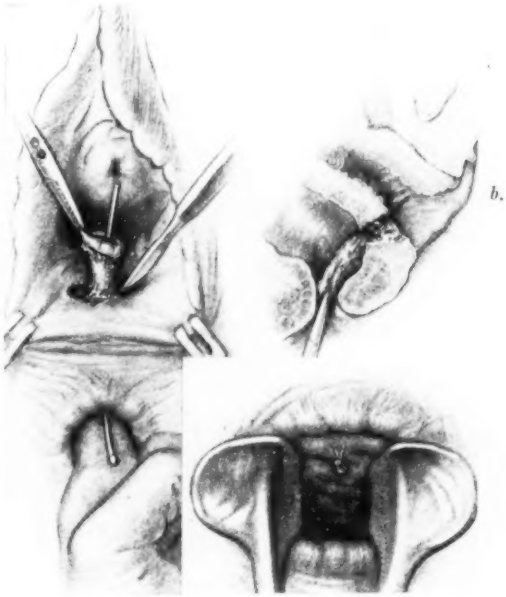
the rectum from the vagina by circular incision and blunt dissection so as to free the rectal wall and to displace the upper part of the tear down to the level of the skin. The rectum was sufficiently separated from the vagina to permit it to be displaced without tension.

Dr. Howard Kelly[1] describes a flap operation and individual suture of the sphincter muscle, and disposes of the flap by folding it upon itself transversely (Fig. 3). Dr. Kelly called attention to the necessity of making a fleshy flap to lessen the danger of sloughing. Kelly's operation accomplished repair without suture of the rectum. Individual suture of the muscle was initiated.

Figures 5, 6, 7, and 8 illustrate features in the development of perineorrhaphy for complete tear which was presented before this society by me some years ago. The flap was made sufficiently high so that all sutures when placed were a considerable distance away from the anus and thus minimized the danger of fæcal contamination.

Figure 6 shows the method of exposing the muscle by means of blunt dissection with the Mayo scissors. Figure 5 shows how all the tissues between the free ends of the sphincter are separated down to the rectal mucosa to facilitate approximation of the muscle. Figure 7 illustrates how the muscle is grasped with an Allis forceps and elevated into the wound. Figure 8 illustrates the torn ends of the sphincter muscle in approximation. The separation of the vagina from the rectum was made by blunt dissection after the method described by Noble, so that the upper part of the torn rectum was displaced down to the skin level. The flap was incorporated into the

[1] KELLY. Operative Gynecology, 1906, i, 288-89.



a. *c.*

Fig. 9*. *a.* The fistula is dissected free down to the rectal mucosa. *b.* The fistula is inverted into the rectum. *c.* Rectal exposure. The freed fistulous tract is ligated and the redundant tissue excised.

* From Surgical Clinics of Chicago.

Fig. 10. Fig. 11. Fig. 12.

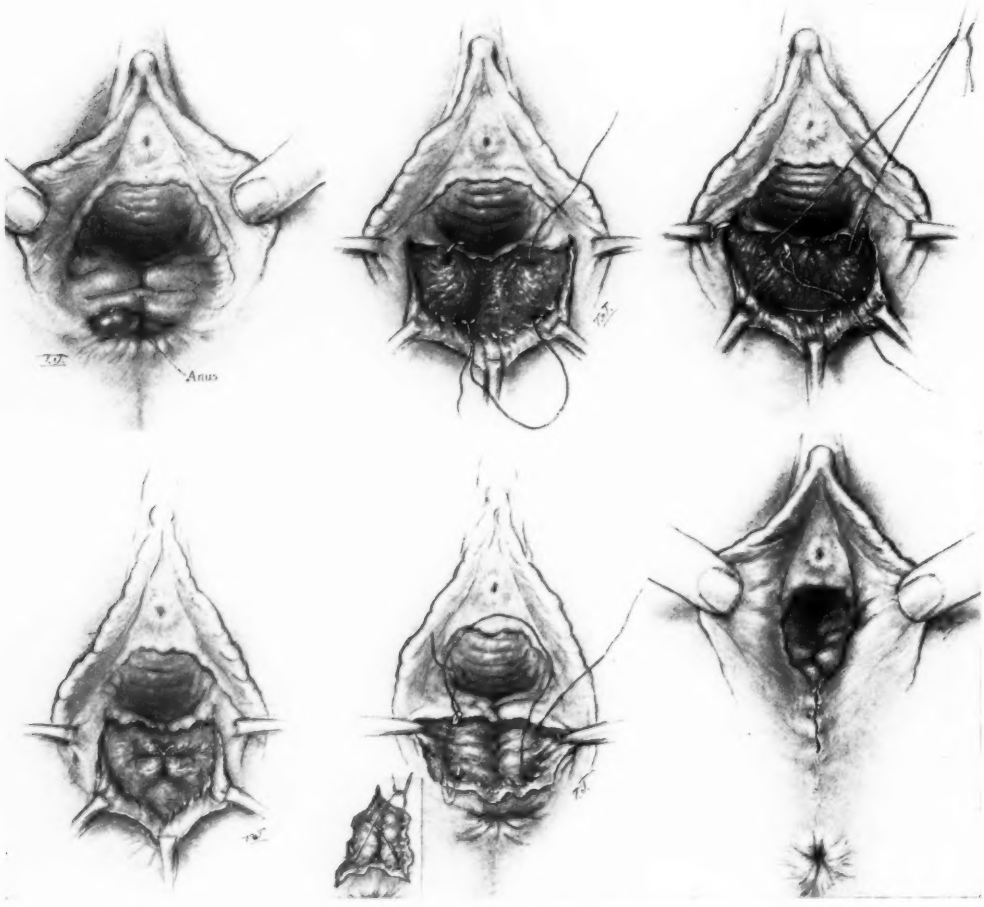


Fig. 13. Fig. 14. Fig. 15.

Fig. 10. Drawn from life.

Fig. 11. Shows flap made. No tissue has been removed. Suture passed through levator muscle and fascia deeply enough to grasp separated ends of torn levator ani muscle.

Fig. 12. Two subcutaneous sutures have been inserted and tied and a third is being placed to close upper part of wound.

Fig. 13. Appearance of wound after the sutures described have been tied.

Fig. 14. A second circular suture is being introduced. Note inclusion of sphincter ani by needle.

Fig. 15. Submucous and subcutaneous suture completes closure. Note the distance of the wound from the anal aperture.

wound by successively including a part of it in the sutures after the method employed by Tait[1] in his flap-splitting operation.

Figure 9, *a*, *b*, *c*, illustrates an operation described by Vernon C. David[2] in the *Surgical Clinics of Chicago* in a clinic on rectovaginal fistula. The illustrations show how the fistulous tract is dissected free down to the rectal mucosa, is then inverted into the rectum, ligated, and excised. This operation is an efficient and simple procedure for the cure of rectovaginal fistula and can be utilized to great advantage in the treatment

[1] TAIT. Diseases of Women and Abdominal Surgery, vol, i, p. 68.
[2] DAVID, V. C. Surg. Clinics. Chicago, 1919, iii, 1439.

of cases of injury of the sphincter ani muscle complicated by rectovaginal fistula. The operative principle is such as to offer a certainty of cure of the fistula. It eliminates the necessity of the usual procedure of cutting through the perineum down to the fistula in treating such cases and thus will often conserve a large amount of important tissue, will increase the proportion of desirable results, and lessen considerably the postoperative disturbances of the patient. In cases where there is not sufficient tissue to invert and ligate, the freed tract can be purse-stringed in the vagina and the purse string can be pulled through the opening into the rectum and tied. By utilizing a purse-string in this manner and by making a considerable vaginal flap when needed, a rectovaginal fistula of considerable size can be efficiently repaired.

Figures 10 to 15 illustrate a perineorrhaphy for complete tear which I now practice. The illustrations are exact reproductions of drawings made at the time of repair of the laceration shown in Figure 10. Figure 11 shows the flap formed and the tissues separated down to the rectal mucosa and the suture passed deeply through both ends of the torn muscle. Figure 12 shows the suture which has been passed through the torn muscle on either side and held by a forceps. A second suture is being introduced which includes the torn part of the levator ani muscle and its fascia at the upper part of the wound. Figure 13 shows these two sutures tied and the ends cut. Figure 14 shows a continuation of the closure of the wound. Figure 15 shows the perineorrhaphy completed.

The features which we believe to be important are:

1. The flap is formed so that the sutures are a considerable distance from the anus. The flap is fleshy, especially at the sides, so as to lessen the dangers of sloughing. All tissues between the muscles are separated down to the rectal mucosa so as to facilitate approximation of the severed ends of the sphincter muscle. Separation of the rectal from the vaginal mucosa is extended sufficiently to permit the upper part of the rectal tear to be displaced down to the skin level, as advocated by Noble. The flap is incorporated into the wound by passing circular sutures so that part of the flap is successively included, a procedure which Tait developed in his flap-splitting operation for complete tears.

2. The torn sphincter muscle is not dissected free and sutured individually. After considerable experience I became convinced that it was undesirable to do this because the freed muscle is not desirable tissue for suture. The sutures either cut through the muscle or cause atrophy and the muscle is considerably injured by dissecting it out and by pulling it into the wound. We believe that by allowing the scar tissue to remain over the torn ends of the muscle that much better tissue is obtained for suture, as all muscle to muscle union is a connective-tissue union and the presence of a little more or less scar tissue is of relatively small importance. The sphincter muscle is anatomically so closely incorporated in the levator ani muscle that it can be sutured advantageously with the levator ani muscle and fascia.

RESULTS

The danger of rectovaginal fistula resulting, which has always been a prevalent one without the flap operation, is eliminated. The muscular control is certain if the sutures include the sphincter muscle and if primary union results. With moderate care good muscular control should be obtained. The danger of constriction at the anus which always obtained where the rectal mucosa was sutured separately, is eliminated by the flap operation. Contamination of the wound from fæces is no more liable to occur than in perineorrhaphies for incomplete tear. Postoperative distress should not be much more than in simple perineorrhaphy if the tissues are approximated without much tension. Postoperative attention to the bowel is the same as after simple perineorrhaphy.

SCOLIOSIS

By S. KLEINBERG, M.D., F.A.C.S., New York

DURING the past few years there has been a relapse of indifference regarding the treatment of structural scoliosis. This is due, I believe, not so much to helplessness as to disappointment at the failure of certain proposed methods. The reader will recall that in 1911 and 1912 it was proposed that forcible correction for scoliosis should be applied with the trunk flexed. It was claimed that when the trunk is flexed the vertebræ are unlocked and can be rotated and displaced, and hence a curve of the spine can be readily straightened in this position. The theory was plausible, the method very complicated and seemingly effective, and the pictures of so-called corrected scolioses fascinating. There had been in addition such a long period of indifference and the embarrassment of the lack of "something new" in the line of treatment had reached such a marked degree, that most men were in a receptive mood for a new method. The proposed treatment of the scoliotic in flexion was, therefore, received with eagerness and enthusiasm and was rapidly put to the test on a very extensive scale throughout this country.

The enthusiasm for a while led most of us to believe that the presence of bulging ribs where there used to be a hollow indicated a cure or a close approach to a cure. We paid no attention to the patient, the greatly distorted appearance, the presence of extensive pressure sores, the malformation of the chest — for these were all incidental and were sacrifices made to obtain a straight back. Soon, however, we learned that the appearance of the back and chest was deceptive, for the curve of the spine was not straightened and seeming improvements disappeared almost completely, soon after the supporting jacket was removed. Gradually we discarded this, the Abbott method, and sought another.

It seemed to us that our first duty was to use some method that would at least not make the patient look worse and that would be attended with the minimum of discomfort. We decided to proceed slowly, to change jackets often and not to impose additional deformity by using awkward postures, pressure pads, etc. It soon became apparent that the safest as well as the simplest method was the old treatment with the spine in extension. We learned, however, that its effectiveness depended to a large measure upon continuity of treatment, and that it was poor practice to relax the spine from the new and corrected attitude and thus interrupt treatment during the time when a jacket was removed and the patient prepared for a new plaster.

At first, at the suggestion of Dr. Whitman, the treatment was carried out with the spine hyperextended, the arm on the "hollow side" abducted to a right angle or even raised to the vertical position and the chest rotated toward the side of the convexity. The rotation of the chest *toward the side of the convexity* resulted from pulling the "high" shoulder downward and backward. It was accidental in this treatment but is, I believe, of some importance. This method was not very uncomfortable and gave a certain degree of correction. Considerable difficulty was, however, encountered on account of the numbness and weakness of the elevated arm. Finally we adopted a slightly different method which we will presently describe, and which, used in a fairly large number of patients, has given very encouraging results. The most gratifying of our experiences with this method is that in the majority of cases—60 to 70 per cent, excluding thus only the razor-backs, severe kyphoscolioses, and cervicodorsal curves — we can surely prevent the deformity from getting worse and can with reasonable certainty predict marked improvement.

PREVENTION OF SEVERE GRADES OF SCOLIOSIS

The opportunity of preventing a given deformity from progressing is of paramount importance, for it means that under ideal conditions, namely, early recognition of the deformity and prolonged and continued treatment, we can eliminate the severer grades of curvature of the spine. The great obstacle we encounter in the effective control of scoliosis is the tendency to delay or interrupt treatment until the deformity has advanced to the severe grade. So many excuses arise. The weather is too hot; the cast will be heavy; my girl is preparing for graduation; we will send her to the country to get stronger; let us try exercises first. These and a thousand others are offered to us and only too often the physician acquiesces to the detriment of the patient.

Our chief concern for the present is to prevent the scoliotic deformity from getting worse. We try to improve it if we can. There is no known

method that enables us to *cure* a structural scoliosis. If, therefore, the scoliotic *comes* for treatment when the deformity is mild and we can keep it mild, we shall have scored a distinct success. But to prevent the occurrence of severe grades of scoliosis, the curvature must not only be recognized early, but immediate *corrective* treatment must be instituted and continued for years without interruption. No case of structural scoliosis, even a mild one, can be successfully managed unless the treatment and observation are continued for at least 5 years — and often much longer. This fact must not only be borne in mind by the physician, but impressed upon the patient or her guardian. We have frequently ourselves to blame for poor results. When we have applied a dozen or fifteen jackets to a patient during a period of 2 years, the patient, her parents, or often the doctor, begin to wonder when the process of changing jackets is going to end. Some one suggests an interruption for a week to see what results the jackets have wrought. This is a dangerous period, for when jackets are once discontinued, the patient is disinclined to renew wearing them. The patient frequently at this time takes occasion to consult other physicians; and not only is the period lengthened beyond what had been intended but an inexperienced physician may be consulted and unintentionally cause permanent interruption of the treatment. Thus the patient within a short time may lose what it had taken months to accomplish.

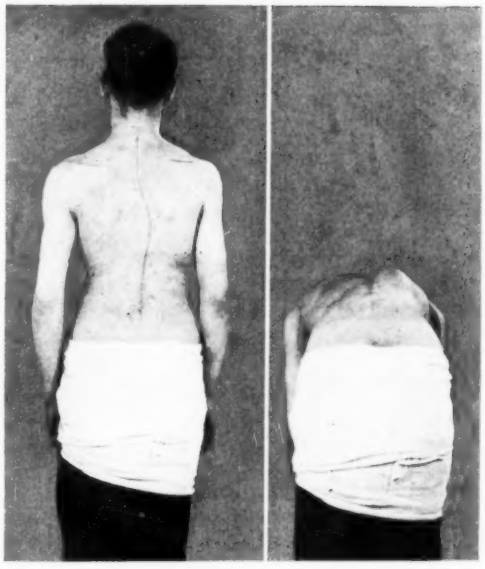


Fig. 1 (at left). Right dorsal scoliosis showing lateral deviation.

Fig. 2. Right dorsal scoliosis showing rotation and backward projection of ribs on right side.

PROGNOSIS

We all know that scoliotic deformities frequently advance to a terribly severe degree. We all know how distorted and misshapen are the patients with so-called razor-backs. Yet all these deformities were at one time very mild. How fortunate it would be for these patients if their deformities could have been arrested in their progress and kept mild. It would be a real accomplishment. To be sure in some instances the deformity stays mild. But we are not in a position to say which cases will stay mild and which will progress. We must assume, in the light of our present knowledge, that in any given case the deformity unless it has been stationary for a number of years, may get worse. We saw only last week two adults with advancing scoliotic deformity. Our experience has shown that a case of rigid scoliosis will not improve without treatment. This observation is a sufficient reason for instituting treatment as soon as the diagnosis is established. Without treatment, therefore, the prognosis is very poor. The deformity will neither disappear nor improve of its own accord and may at any time become worse.

In this connection it is well to consider gymnastic exercises as a corrective agent of rigid scoliosis. To be corrective, exercises must have selective and definitely limited action in order to cause untwisting of the spine. That is not possible, for a given movement of the trunk and body involves practically all of the muscles of the back and not a few isolated muscles or a single group of muscles which could exert a selective action. Moreover, a muscle acts in co-ordination with and not to the exclusion of all other muscles. By constant exercise the patient may, to be sure, learn to assume an improved posture and the curve may momentarily appear improved. That, however, is the limit of accomplishment. The child being treated by exercises must not be judged by her appearance in the gymnasium but by her postures at home and in school.

Treatment by exercises alone may even be harmful for (1) mobilizing the spine may afford an opportunity for the curve to grow worse and (2) the patient and her guardian believing the exercises to be curative rest undisturbed until much valuable time has been lost. From the patient's point of view treatment by exercises

is the method of choice. It is, however, only after a year or more has passed in this treatment and the deformity has become noticeably worse that the confidence in exercises is shaken and additional advice is sought. We know many patients who have gone through this experience.

Gymnastic exercises of whatever kind cannot, in my opinion, correct a structural scoliosis — a deformity the correction of which involves change of the structure and relationship of bones, muscles and ligaments. And why should we expect exercises to be corrective? Treatment by exercises consists merely in drilling the patient for an hour a day or every other day in different forced poses and postures. What series of postures, each one of which is maintained for a minute or two, can change the morphology and architecture of a vertebra, the attachment of a muscle, or the structure of a ligament? When viewed in this light, gymnastic exercises must necessarily appear ineffective as a really corrective treatment. The pity of it all is that because a case is considered mild, exercises are thought sufficient. It is just at this time that corrective treatment would be most beneficial. The loss of this favorable period is a great detriment in the progress of our work in scoliosis. The point I desire to emphasize is that *active corrective treatment* should be instituted just as soon as the diagnosis of structural scoliosis is made.

The diagnosis of scoliosis can and should be made early. The most effective preventive work can be done in the schools through the early recognition of the deformity. Not only should proper precautions be taken by the school authorities to install the most approved desks and seats, to see that the children maintain proper postures during their work, to give them appropriate periods of exercise and recreation, etc., but each child between 6 and 15 years of age should have its *naked* back examined at least once a month. It takes a trained eye but a few seconds to recognize a curvature of the spine and very many children can be examined in a short period. In this way cases of scoliosis would be discovered in their incipient stage and by treatment would be kept mild.

PRINCIPLES GOVERNING THE CORRECTIVE TREATMENT OF STRUCTURAL SCOLIOSIS

Although all the tissues of the trunk are involved in structural scoliosis, we are concerned chiefly about the condition of the spine, for no real improvement can take place without definite change in the shape and structure of the vertebræ and spinal column. The position and curve of the spine is, therefore, an index of any change in the deformity.

While we are greatly in doubt as to the exact primary cause of scoliosis, there is no doubt that the force of gravity is at least an important factor in maintaining and even increasing the deformity. In all except the most extreme cases suspension and elimination of the force of gravity are sufficient to reduce the scoliosis. We have seen repeatedly cases show marked reduction of the curve of the spine when the patient is in the prone or supine position, and very marked distortion and aggravation of the curve in the sitting or standing position. This is especially true of paralytic curves. We must, therefore, use some apparatus, usually a plaster-of-Paris jacket, to support the trunk and eliminate as far as possible the force of gravity as a factor operating on the deformed vertebrae.

The tissues on the hollow side of a curve are contracted, those on the convex side are stretched and enlarged. This is true of the muscles, the ligaments, and the bones. To correct the curve we must alter the structure and shape of the tissues. In some deformities such as bow-legs and knock-knees the parts involved are accessible and by manipulation or operation their conformation can be changed and the deformity corrected. In scoliosis, on the other hand, the important structures, namely, the vertebræ and the muscles and ligaments attached to them are inaccessible and therefore they can be influenced only by indirect methods.

We know that the structure of tissue, especially bone, depends upon its function and that change in function will result in change of structure. We take advantage of this principle of adaptability in the treatment of scoliosis. In a curvature of the spine the weight of the head and trunk comes chiefly on the side of the vertebræ toward the concavity. The vertebræ are thickened on the concave side and rarefied on the convex side. This is readily seen in a cross-section of a wedge-vertebra. To change the structure of the vertebræ, their function must be altered. If we can shift the center of gravity and the line of weight of the trunk so that it falls equally on the different parts of the vertebræ, or preferably on the convex side of the vertebræ, the function and hence the structure of the vertebræ will be changed. To accomplish this we place the patient in an attitude directly opposite to that of the deformity, thus stretching the contracted parts, relaxing the stretched tissues, and shifting the line of weight bearing. In a right dorsal curve, for example, the right

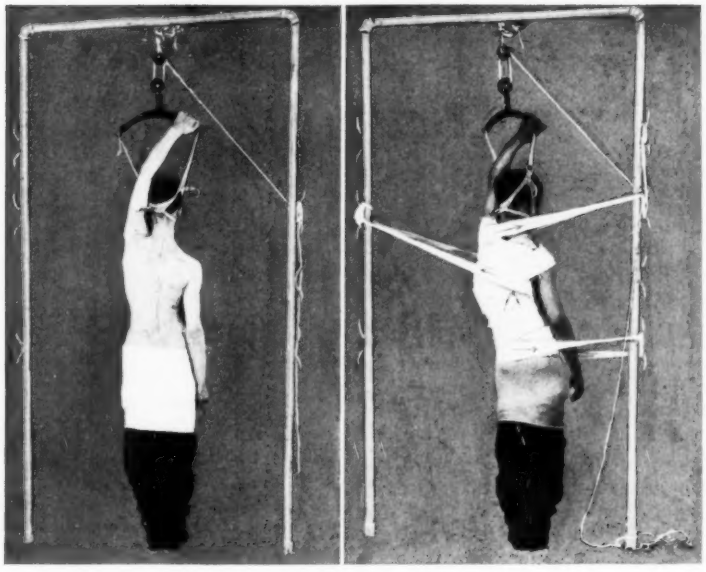


Fig. 3 (at left). Correction of curve under suspension.
Fig. 4. Position of trunk and limbs, number of traction bands, and direction of pulls.

shoulder is high, the left shoulder is low, the tissues on the right side of the dorsal spine are stretched while those on the left side are contracted, and the weight of the trunk is borne chiefly by the left halves of the vertebræ. If the patient is placed in a position in which the left shoulder is high and the right shoulder is low, and the trunk shifted to the left, the tissues on the left side of the spine will be stretched, those on the right side relaxed, and the center of gravity will be shifted to the right, so that the line of weight bearing will fall upon the middle of the vertebral bodies or nearer the right than the left border of the vertebral bodies. As a consequence the function of the vertebræ is changed, and in time their structure will be altered. Of course, change in function must operate for some time to effect a change in morphology. From the preceding observations we may conclude that the second principle governing the treatment of scoliosis depends upon a change in the posture of the patient in a direction opposite to that of the deformity.

Lastly, the spine may be likened to a bent rod which is straightened by holding its extremities and pressing on the most curved portion. In scoliosis, the extremities of the spine, namely the pelvic and shoulder girdles are fixed, and corrective force is applied at the site of the greatest convexity.

The principles observed in the treatment of rigid scoliosis are, therefore, the following:

1. Support of the trunk by an apparatus, usually a plaster-of-Paris jacket.
2. Change of the patient's posture to one directly opposite to that of the deformity.
3. Fixation of the pelvis and shoulders, and application of corrective force over the convexities.

The above principles are followed practically universally in the treatment of scoliosis. We may argue at great length as to the exact mechanism of production of scoliosis; we may argue at still greater length as to the value of the different elements of our favorite treatment; but we are all agreed that to straighten a curved spine it is necessary to immobilize the pelvis and shoulders and to apply pressure over the convexities. In the ultimate analysis all methods are alike in this respect.

CORRECTIVE TREATMENT

There has always been great difference of opinion in regard to the best position of the body for the application of corrective force. During the last 4 years the writer has used the extension

method exclusively. Taking a typical case of moderately severe right dorsal scoliosis, the procedure is as follows:

The patient having put on a seamless shirt, or preferably two shirts, is suspended in a Sayre head sling. At first she is pulled up so that she rests on her toes. After a few seconds she is asked to get down on her heels and if she has not been pulled up too high she can do so. If one waits now a minute or so, the patient can be pulled up farther and still remain on her heels. The more flexible the spine the farther can the patient be pulled up without raising the heels from the ground. Finally we get to a point where we cannot pull the patient up without raising her heels off the ground. If now we relax the pull just a little the patient is suspended to the maximum degree that will permit application of the jacket without intolerable discomfort. The position with the heels resting on the floor is important because the lumbar lordosis is reduced and the pelvis is in proper relation to the trunk, while if the patient rests on the toes the pelvis is frequently tilted forward abnormally. Suspension carried out as here described is sufficient in all but the severest cases to reduce the curve of the spine and improve the appearance of the back.

The left arm is then raised and the hand grasps the *right* side of the cross-bar. This stretches the left side of the chest and helps to increase the correction. The patient is encouraged to elevate and stretch the left arm as much as possible. This stretching may be increased by an assistant who grasps the arm and pulls it upward and to the *right*. A large removable pad of felt is then placed between the two shirts on the left or hollow side of the back. This pad is large enough to reach from the spine to the anterior axillary line and from just below the shoulder to about the second lumbar vertebra or termination of the dorsal curve. This pad must be fairly thick so that when it is inserted the back is symmetrical; or so that the left or padded side is a little higher than the right. At the periphery the pad thins down gradually so that the plaster passing over it on to the chest will not form a sharp ridge. When the jacket is completed this pad is removed and if it has been big enough there will be a large opening in the plaster to allow for expansion of the hollow side of the chest. The entire trunk is then thoroughly protected by several layers of thin felt, evenly applied. Extra padding is placed over the areas which will be subjected to considerable pressure. These are the convexity on the back, the crests of the iliac bones, the posterior part of the left shoulder, the anterior and upper aspects of the right shoulder, and the left side of the front of the chest.

If the patient is very sensitive or is troubled with any gastro-intestinal disturbances, it is well to insert a towel under the shirts over the abdomen. This is later removed and allows for distention of the abdomen without undue tension or distress. If the patient is a girl with well developed breasts, extra padding is placed over them. The pelvis is fixed by a traction band pulling to the right. In the same way the shoulders are fixed; this traction band inclines upward so that not only does it immobilize the shoulder girdle but in addition it pulls the left shoulder upward and aids in the correction. Another traction band of muslin or flannel is passed about the right side of the chest over the most prominent part of the convexity. This band is pulled to the left and is the main corrective traction band. To avoid undue pressure, an extra thickness of felt is placed over the convexity under this band. When these different bands are tightened, there is a further reduction of the deformity. The bands are pulled only as much as the patient can comfortably tolerate and not any more. If too much force is used, the patient is subjected to discomfort, which may lead to fainting and compel the operator to interrupt the plaster work when he is half way along or even almost done.

A word of caution in regard to tolerant, especially willing, and to paralytic patients. These patients may permit the use of a great deal of traction at the time the bands are being adjusted. It is well not to pull too much, for the pressure may become too great, and despite the forbearance of the patient, fainting or even shock may supervene. The right or high shoulder is pulled downward and backward by an assistant. This causes a rotation of the chest toward the convexity of the curve. The chest may be rotated almost 90°. Rotation of the chest toward the convex side of the curve was first suggested by Dr. A. Mackenzie Forbes, and without going into detailed study of the effect of this manœuvre, there is no doubt that it causes a decided reduction in the deviation of the spine. Theoretically it is argued that this twisting of the chest causes an enlargement or expansion of the contracted side (in our case the right side). Practically we find that whereas with the Abbott method the compressed side of the chest became more compressed with this method the transverse diameter of the contracted side remains as it is or becomes larger. Twisting of the chest toward the side of

the convexity is, therefore, an advantage because it is helpful in reducing both the deviation of the spine and the compression of the chest.

When these preparations are completed, the patient is in an improved attitude. She is from 1 to 2 inches taller. The spine feels straighter. The convexity is less marked. The hollow is distinctly reduced. The shoulders have been reversed in their relative position and the contracted side of the chest is wider.

We then begin the application of the plaster bandages. In order to make the jacket very strong and to reduce the time occupied in applying it, it is helpful to have an assistant prepare plaster pads or reverses to reinforce parts of the jacket that should be very strong. We first apply the plaster over the pelvis going fairly low down to the coccyx, rolling the plaster so that the jacket will fit very snugly about the pelvis. The jacket is completed in the ordinary way and includes the right shoulder. On the left side the plaster reaches to the spine of the scapula. In order to bring the right shoulder down as far as possible, the plaster bandages pass under the axilla, over the shoulder from behind forward, and then down over the right scapula toward the left iliac crest. In this way not only is the right shoulder depressed and held so without the aid of an assistant, but in addition the right scapula is rotated backward and the prominence of the angle of the scapula is reduced. Plaster pads or reverses are applied over the right shoulder, across the back of the left shoulder, over the convexities of the chest back and front, and across the back at the dorsolumbar junction. Just about the time the plaster is hardening it is molded over the convexity so that it may fit very accurately. When the plaster has hardened, it is trimmed in the usual way except that it is left on, over the right shoulder, and is cut as high as possible with comfort to the patient under the left shoulder. A large window is cut out of the plaster on the left side in back and the removable pad is taken out. This allows for expansion of the hollow side of the chest. If the plaster has been molded properly over the convexity, the right side of the chest will be restricted in its excursions, and respiration will cause increased mobility and consequent expansion of the hollow side of the chest. When the jacket is completed, it is asymmetrical, the left side being larger and longer.

An asymmetrical plaster jacket for scoliosis is different from the ordinary jacket, for instance, for Pott's disease. In the latter case, the jacket is applied with uniform pressure for efficient support. In the former, the pressure is uneven. We desire extra pressure over the convexities back and front, over the right shoulder in a backward and downward direction, and in back of the left shoulder to hold it up high and keep it forward. These regions, as well as the dorsolumbar region must be reinforced, for a big window is to be cut out of the plaster. On the other hand, we do not desire any pressure over the abdomen or over the back on the left side, and here the plaster may be very thin. The plaster bandages are, therefore, rolled on with all these important points in mind.

Fig. 5 (at left). Corrective plaster jacket, back view.
Fig. 6. Corrective plaster jacket, front view.

When we are dealing with a double curve, let us say a right dorsal left lumbar curve, in which the lumbar curve is well marked, we utilize an extra traction band to pull the lumbar spine to the right. In addition we provide for correction of the lumbar deformity by inserting a removable pad on the right side of the lumbar region. This is removed through a window, cut over this section. If the front of the right side of the chest is markedly compressed, it is well to allow for its expansion by placing a removable pad over it. This pad must extend from the angles of the ribs over the lateral aspect of the chest to the sternum. It is not sufficient for this pad to be placed over the front of the right side of the chest, for the lateral compression of the chest begins and in fact is most marked near the angles of the ribs.

If the curve involves the upper dorsal or the cervicodorsal vertebræ, the plaster must include both shoulders and extend to the occipital protuberance in the back and the chin in front, *i.e.*, a Calot jacket.

A plaster jacket should be left on for from 1 to 2 months. More frequent changes are not advisable, for having stretched the back, we must allow sufficient time to elapse to permit the tissues to adjust themselves to their new position.

Formerly we used to use felt pressure pads and inserted them under the plaster over the convexities. These do perhaps increase the correction but they cause great discomfort and frequently pressure sores, and if the plaster has been applied properly, they are very difficult to insert sufficiently accurately to produce the desired result. It is, I believe, better to do without them and to depend upon the shape of the plaster to effect and maintain correction of the curvature. Considerable corrective influence may be gained by practicing forced breathing for 10 minutes every 2 hours in the "keynote" position. During these breathing exercises, the patient forces herself over to the left side by elevating the left arm as far as possible with the hand over the back of the neck and the head inclined to the right side.

The aim in applying a new jacket is to correct the spine a little more or hold the patient in a better position than in the preceding one. The interval between jackets is determined by the time it takes to fill in the jacket. That is, when the chest on the hollow side reaches the plaster and has no further room for expansion then it is time to change the jacket. Or, if at the end of 4 or 5 weeks the jacket is very loose, it must be replaced by a new one.

The patient is then suspended until she is resting lightly on her heels. The jacket is removed. The skin is washed and the patient is prepared for a new jacket. Additional suspension and traction are now applied and increased correction obtained. In this way we do not allow the tissues to relapse to their original condition. We keep whatever correction we have gained in the last jacket and add to it. On many occasions following the older procedures, it has been noticed that a second jacket did not improve the patient any more than, in fact sometimes not as much as, the first jacket; whereas if the patient is not allowed to relapse when a jacket is being changed, the second jacket almost always shows a gain in correction. The writer has become convinced of the efficacy of this detail in the treatment and recommends its adoption.

Ordinarily a patient, who has had a jacket applied with the spine in extension, is inconvenienced for only a few days. She soon accommodates herself to the new position and is able to continue with most of her daily routine. The writer has a fairly large number of patients treated with "straight" jackets who attend school regularly, take music lessons, etc. They hardly ever lose more than one day from school at the time a new jacket is applied, and the treatment is at no time unbearably uncomfortable.

In the treatment with the spine in extension, we seek with every jacket to place the patient in a posture in which the back appears improved as compared with its original condition. As a result of this, whether the patient is cured, improved, or not improved, we never make the patient look worse than he did before the treatment was begun.

CONCLUSIONS

The most effective means of recognizing scoliosis early is by regular frequent examinations of the naked backs of all school children.

Corrective treatment should be instituted as soon as the curvature of the spine is discovered.

Treatment should be carried on uninterruptedly for years until improvement has been obtained and until such time as will reasonably assure arrest of the deformity.

Treatment with the spine in extension is at present the best form of treatment for it enables us to arrest the progress of the deformity and in many instances to reduce the curvature. It is the least uncomfortable treatment and does not cause malformation of the chest. The essential feature of the treatment is keeping the patient in a position that is opposite to that of the deformity.

During change of jackets there must be no opportunity for relapse of the deformity.

PURULENT PERICARDITIS

A Closed Suction Technique for Drainage; Report of a Case

By WYMAN WHITTEMORE, M.D., F.A.C.S., Boston

UNFORTUNATELY, from the surgeon's point of view, cases of purulent pericarditis that come to operation are extremely uncommon. In 1900, C. B. Porter reported in *Annals of Surgery* for December, 51 cases of incision for pericarditis, collected from literature; 20 recovered and 31 died, a mortality of 60.5 per cent. During the last 32 years at the Massachusetts Ceneral Hospital, there have been only 2 cases operated on. The first was successfully operated upon by C. B. Porter in 1900, and the other is the case reported here.

The only operative proceedure that has been reported, or at least that I have been able to find in literature on this subject, is an open drainage technique, the details of the operations varying slightly according to the operator but the main factor being a resection of a portion of a rib cartilage and wide opening of the pericardium, drainage being taken care of by one or two large tubes. Practically all cases were irrigated with salt solution or some mild antiseptic solution.

In 1912 Boxwell in the *Dublin Journal of Medical Science*, for August, says: "A pericardial effusion requiring any surgical intervention at all ought to be treated by resection of a rib cartilage and free opening of the sac. . . . It is the only safe and satisfactory method." If one delays operation until there are masses of fibrin present then open drainage surely gives the patient his only chance, but I believe that operation should be done before masses of fibrin form. Furthermore, if one remembers that the patient is lying on his back in bed, the operation of resecting a rib cartilage and opening the pericardium is merely lifting the top off an abscess cavity and not making any effort to drain the abscess at its most dependant part. With a patient lying in bed the most dependant part of the pericardium is the posterior sulcus, which is situated half way between the apex and the base of the heart, and this is the most important region to drain. In this old classical operation, it seems probable to me, that in many cases this posterior sulcus was never drained. In pneumococcus infections of the pericardium, which are the most common that require surgery, masses of fibrin and adhesions rapidly form, so that, if this posterior sulcus is not drained it will soon become walled off from the anterior part of the pericardial cavity, which has been drained,

Fig. 1. Encapsulated empyema on left. Pneumonia on right. May 9, 1920.

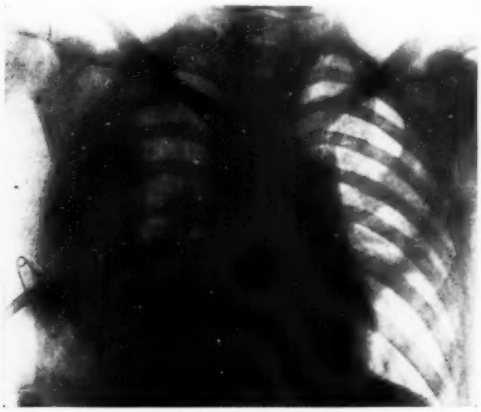


Fig. 2. Tip of catheter draining most dependant part of encapsulated empyema. May 10, 1920.

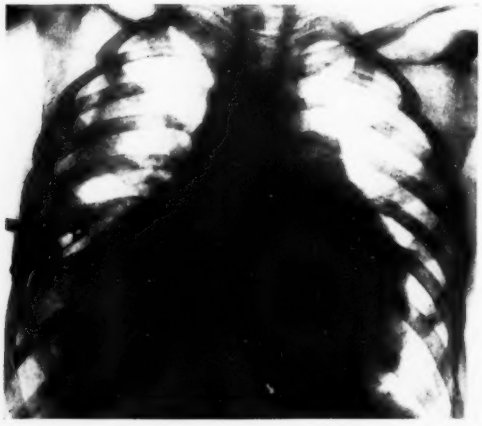


Fig. 3. Heart shadow enormously increased. Empyema cavity empty. May 15, 1920.

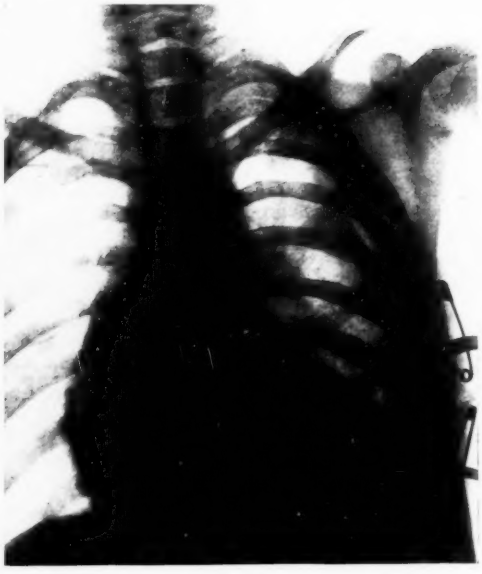


Fig. 4. Heart shadow back to normal. Catheter draining pericardium in place, and catheter draining empyema in place. May 26, 1920.

and never drain at all and the patient will eventually die. I believe this has a great deal to do with the high mortality in these cases.

Believing that the posterior sulcus must be drained, the following technique was thought out. This was suggested to me by the closed suction technique that I have been using for several years in early cases of empyema. By this technique the posterior sulcus can be drained, the fluid can be emptied from the pericardial cavity slowly, which is probably important if there is a large amount, and furthermore no air is allowed to enter the pericardial cavity. I realize that we do not know just how much harm air in the pericardial cavity does, but it seems wise not to allow any to enter if it is possible to keep it out.

TECHNIQUE

Under local anæsthesia (novocaine ,1 per cent) an incision about three-fourths of an inch long is made in the fifth interspace, just inside the border of dullness. The muscles, pericardium, and pleura, if there is any, are anæsthetized. The pericardium is extremely sensitive, and it is necessary to use a considerable amount of novocaine. A long trocar with cannula large enough to admit a No. 10 French catheter is pushed through the pericardial wall. It is necessary to have a fairly sharp trocar and one must use considerable force in going through. One must use much more force than in going through the pleura. The pericardium will give in front of the trocar, the trocar tending to push it away rather than to go through it easily and therefore one must use a sharp trocar. Having gotten into the cavity with the trocar, a No. 10 French catheter that has been shut off with a hæmostat is quickly slipped through the cannula. The catheter is then pushed in a long distance: far enough to allow the tip to go around the apex of the heart and then half way up to the base. In my case this was between 8 and 9 inches from the skin. The catheter is sewed in tightly. Suction is made with a large glass syringe and no air allowed to enter the pericardium at any time. The pus can be emptied out slowly. Suction is done every 1 to 2 hours for the first 24 hours and then every 2 hours until the amount obtained at each time is only 3 or 4 cubic centimeters. Then the time is lengthened to 3 or 4 hours and finally to twice only during the 24 hours. When the amount in 24 hours is only 1 to 2 cubic centimeters and this amount does not increase for 4 days, then the catheter is removed.

A boy, 12 years old, was seen May 8, 1920, in consultation with Dr. W. D. Smith of Boston and Dr. F. R. Clark of Newtonville. He had had an attack of measles of ordinary severity from which he was apparently convalescent with normal temperature. On April 27, the following day, he had a sudden chill and high temperature. The temperature had remained about 104°. The white count was 11,200 on the 29th and 27,200 on the 30th. Respiration was extremely limited, breathing shallow, movement

more restricted on the left. Examination showed in the left back from mid-scapula to base, marked dullness, increased whispered and tactile fremitus, loud bronchial breathing, crepitant râles. On May 3, there was severe pleuritic pain on left. The temperature was still about 104°. Examination showed flatness in lower back. May 8, there was flatness in left axilla and back with faint distant breath sounds and diminished tactile fremitus. A needle was inserted just below the angle of the left scapula and 4 cubic centimeters of straw-colored, turbid serum removed. The sediment showed an excess of leucocytes and many bacteria resembling streptococci. There were also signs of a pneumonia at the right base. May 9, patient was moved to the Massachusetts General Hospital where an X-ray was taken. X-ray (Fig. 1) showed an encapsulated empyema on the left, and a pneumonia on the right side. A closed suction operation was done under local anæsthesia (novocaine 1 per cent). A small amount of thin pus drained out during the first night and the next day irrigations with Dakin's solution were started and kept up every 2 hours until the empyema was well. Forty-eight hours after operation the left ear began to discharge pus and the right ear drum was bulging. This was opened without any anæsthetic by Dr. Tobey. X-ray (Fig. 2) taken the day after operation shows tip of catheter draining the most dependant part of empyema cavity. On May 15, his temperature was 100° to 102°, respirations 35, pulse 110, and he looked bad. X-ray (Fig. 3) showed the heart shadow enormously increased and the empyema cavity empty. Aspiration of the pericardium in the fifth interspace, just outside the nipple line and inside the border of dullness, gave thin pus showing under the microscope many leucocytes and a rare organism resembling the organism from the empyema. This organism was finally proved to be a pneumococcus type 1. Drainage of the pericardium was done by the technique already described. Twelve hundred cubic centimeter of pus was removed during the first 24 hours following operation. X-ray (Fig. 4) was taken 11 days after this operation. This shows the catheter in place with the tip draining the posterior sulcus and the heart shadow back to normal size. The amount of pus gradually diminished until at the end of 4 weeks, there was less than 2 cubic centimeters obtained each 24 hours and then the catheter was removed. The following day the drainage tube was removed from the empyema. Smear taken from both cavities showed less than 1 pneumococcus in 5 fields and a rare staphyloccocus. Both sinuses healed promptly and at the end of 8 weeks from the time he entered the hospital he was up walking about a little, with a temperature no higher than 99°. The following day the skin over both mastoids was found œdematous and immediate operation was done under ether, by Dr. Tobey. The patient stood the operation very well. He made an uneventful recovery. He left the hospital 3 weeks later with the wounds entirely healed.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD NOVEMBER 19, 1920, DR. ARTHUR H. CURTIS, PRESIDING

BASAL METABOLISM IN PREGNANT WOMEN

DR. JOSEPH L. BAER: I have recently been studying basal metabolism in pregnant women in a series of cases and have had the privilege of determining the basal metabolic rate in a rather unusual case which I would like to report because of its possible diagnostic significance.

In general, the problem I am working on now consists in determining basal metabolic rate in normal pregnant women in the last 4 weeks of pregnancy and then again immediately after delivery, in an attempt to determine whether the difference in the two rates is greater than is accounted for by the loss in the woman's weight. Through the courtesy of Dr. Frankenthal, I was permitted to estimate the metabolic rate of a woman 36 weeks pregnant in whom a dead fœtus had been diagnosed 3 weeks before the time I saw her. Several estimates of her metabolic rate averaged 9 per cent plus. I then determined her metabolic rate shortly after delivery of this macerated fœtus, and it was exactly normal. In other words, this woman was near full term yet showed only an elevation in metabolic rate within the normal limit of error; that is, an error in the entire problem of 10 per cent plus or minus is permissible and may be ascribed to personal equation, variations in the machine, etc. Immediately after delivery she had a normal rate. What bearing that will have as a diagnostic measure in the determination of still-births remains to be seen, but it appeals to me as distinctly interesting.

Fig. 1. Case of Dr. Culbertson. Microscopic examination showed it to be simple fibroma.

DR. LESTER E. FRANKENTHAL: It is best not to say anything this evening on the subject presented by Dr. Baer. I would rather wait until Dr. Baer is through with his observations, which, I assume, will take him another year.

The question I would like to hear answered by members of the society is as to how long a time they have known a dead fœtus to be carried in the uterus of a woman. In my patient, just referred to by Dr. Baer, the fœtus was dead more than 3 weeks to my positive knowledge.

DR. FRANK CARY: I have seen one case that went 2 months beyond full term.

DR. CAREY CULBERTON: In 1909 we had a case at the Presbyterian Hospital where the fœtus died at about the fifth month of pregnancy. The patient had missed nine or ten periods; she had felt life when she thought herself to be 5 months pregnant, after which all signs and symptoms ceased. Previous to entering the hospital she had been sick for 4 months with loss of appetite, malaise, headache, backache, and urinary frequency. Examination revealed a mass rising to the pelvic brim, representing an enlarged, soft, boggy uterus. The urine showed a large amount of albumin and numerous granular and epithelial casts. An intact gestation sac containing a dead fœtus of about the fifth month was removed from the uterus, the entire mass being soft and pultaceous. The patient was profoundly toxic and died 2 days later of acute nephritis.

DR. EUGENE CARY: I had a case in the clinic recently that had gone to the eleventh month of pregnancy so far as we could determine. The fœtus had not been alive since the seventh or eighth month, and before anything was done we lost track of her.

FIGURE-OF-EIGHT KNOT IN CORD

DR. WILLIAM C. DANFORTH: Last spring Dr. Davis showed two cases before the society of knots in cords, and I happened to have had one in the

laboratory which was a true figure-of-eight knot, the only one which I have ever seen.

I had a case the other day in which there was a figure-of-eight knot in the cord in an otherwise normal patient. The first case was perfectly normal except the baby was dead by reason of the knot having been drawn tight during delivery. The other case presented no difficulties whatever. The knot was quite loose when the child was born. Neither case had any hydramnion nor any abnormality during pregnancy.

FIBROID TUMOR COMPLICATED BY THE RUPTURE OF A VESSEL

DR. MARK T. GOLDSTINE: I wish to show a specimen of fibroid tumor which presented an unusual feature. The tumor was removed from an unmarried woman, 24 years of age. While scrubbing the floor about 9 o'clock one Monday morning, she suddenly became faint and slightly nauseated. She stood up, grew worse, and was compelled to lie down. About noon she called a physician. Her abdomen was greatly distended and quite rigid. The physician prescribed for her and returned at about 4 o'clock in the afternoon. As her condition was much worse he made a tentative diagnosis of rupture of the bowel. At 6 or 8 o'clock in the evening he had council. The patient was getting progressively worse, and I saw her at about midnight or a little later, at which time she was in profound shock; the hæmorrhage was so profuse that intervention was impossible at that time. She was taken to the hospital, and on Wednesday morning at 9 o'clock we opened the abdomen and found it filled with blood. We cleaned it out carefully; the only bleeding that I could find was due to a ruptured vessel on top of the fibroid. The woman rallied nicely from the operation, but unfortunately died suddenly on the fourth day.

DR. CAREY CULBERTSON: I have four fibroid tumors to show this evening. The first specimen is a large tumor removed from a patient 29 years of age, and is an excellent example of the old so-called "cystofibroma." The specimen is considerably smaller than it was when removed. It weighed 690 grams, was 66 centimeters in smaller circumference, and 79 centimeters in the longer circumference, and contained a thin bloody fluid which did not coagulate. Before operation the abdomen measured 33 inches in circumference at the umbilicus and 17 inches from the symphysis to the ensiform. The patient had never been pregnant and complained merely of abdominal tenderness which had come on gradually during the past 2 years. The pain was present in both the left and right iliac regions and at times was severe enough to cause the patient to go to bed. There was no menstrual disturbance. There had been some leucorrhœa for 18 months and some frequency of urination for the same period of time. Upon section of the tumor, a thin dark fluid escaped, while the greater substance of the interior was made up of a material which closely resembled porous red rubber. These spaces were separated by bands of darkly stained fibrous material representing a fibroid that had undergone red degeneration and in turn had changed to cystic formation. At the lower portion only was there a small area representing the original unchanged fibroid tumor.

This tumor was particularly interesting before operation because, being a cyst it closely resembled an ovarian cyst but on vaginal examination there were a number of points that made it recognizable as a fibroid in the pelvis.

The second specimen is another uterine fibroid that is interesting in comparison with the specimen shown by Dr. Goldstine. The patient was 39 years of age, and came into the hospital complaining of pain in the left iliac region, coming on suddenly one week previously, associated with nausea and vomiting. The pain was sharp and cramp-like, and especially severe on the left side. The patient thought that she had experienced a small painful swelling in the lower abdomen 4 months ago, but this had disappeared entirely until one week prior to admission when it again appeared with pain. There had been no menstrual disturbance except that the periods had been somewhat more profuse for the last 6 months; for 3 months there has been dysuria. Examination showed a tumor in the pelvis not rising above the plane of the inlet and filling the lower pelvis with a soft, boggy mass, so that the diagnosis rested between pelvic abscess, pelvic hæmatocele, and uterine fibroid. When the abdomen was opened the tumor projected a short distance above the plane of the inlet and the pelvis was filled with blood, partly clotted, partly thin, very much resembling that found in ectopic pregnancy. The anterior cul-de-sac was filled with a broken down material which at first glance appeared either to be malignant degeneration, or necrobiosis, that had broken down and had given rise to hæmorrhage. Microscopic section of this material showed it to be a sarcoma. The rest of the specimen is made up of a compound, conglomerate fibroid mass. One large nodule is soft, dark gray in color, with a cheesy area just beneath its capsule. The uterine cavity is small and the mucosa normal. A small sessile nodule is present at the internal os. The other nodules show no change.

The third specimen is from a patient 29 years of age who came into the hospital complaining of pain in the abdomen, the onset of which occurred last November and was severe enough to confine the patient to bed at that time for 3 weeks. Three weeks ago she suffered another severe attack, limited at this time to the left side, with some nausea but no emesis. This patient also has never been pregnant and has had no menstrual disturbance. There has been a vaginal discharge and dysuria dating back also to last November. The patient has experienced some febrile reaction, her temperature during her presence in the hospital not rising above 100.6°,

leucocytosis 8400, hæmoglobin 90 per cent. The lower abdomen was slightly distended by a mass which filled the left quadrant as high as the anterior superior spine, a mass tender and fixed. This also gave us some trouble in diagnosis, since ectopic pregnancy was suspected. Vaginal examination revealed only that the left pelvis was occupied by a mass which was firm, tender, fixed, and continuous with the mass in the abdomen. The specimen is a uterus enlarged by four small intramural fibroids, the cavity being 2½ inches deep with normal mucosa. The larger portion of the mass is a pedunculated fibroid attached to the fundus. It measures 12 by 5 centimeters, is soft, and has a gangrenous area at its upper pole. On section this contained 14 ounces of thin foul pus of colon bacillus odor. This infected nodule had become adherent to the omentum and transverse colon at the point where it was gangrenous. The sigmoid flexure was free but its appendices were infiltrated and adherent to the tumor.

The fourth specimen which I wish to show was presented through the courtesy of my associate at the Cook County Hospital, Dr. Channing W. Barrett. The patient is a young woman 25 years of age who entered the hospital because of a tumor projecting from the external genitalia, which according to her statement, had grown to its present size within the short period of one year. She complained of pain in the lower abdomen, ascribing it to this tumor. There had been some vaginal discharge for 8 years but no menstrual disturbances. The blood gave a Wasserman negative reaction. She had been married 2 years, and had had one miscarriage in the fourth month 6 years ago; no subsequent pregnancies. There was no urethral discharge, no inflammation of Bartholin's glands or of the inguinal glands. The tumor proved to be an involvement of the clitoris. As described before operation it appeared as a large pedunculated tumor arising originally from a pedicle at the clitoris, the size of a cantaloup, freely movable, painless not tender. The labia were thickened showing some erosion, covered with small mollusc-like growths which extended over the vestibule and about the vaginal introitus. The diagnosis lay between fibroma, elephantiasis, and malignancy. Microscopic section showed it to be a simple fibroma.

BREAST INFECTIONS

Dr. Joseph L. Baer and Dr. Ralph Reis presented a joint paper entitled "Breast Infections." (See p. 353.)

DISCUSSION

Dr. Carl Henry Davis, Milwaukee, Wisconsin: During my entire experience in private practice, I have had only four breast abscesses. Three of these have occurred within the last year, two in patients who had had mild influenzal attacks during their pregnancy. Both of these had the abscess develop about 4 weeks after leaving the hospital. Both of them made a slower convalescence than is usual while in the hospital. The third patient, and the only one that developed an abscess while under my care, was one who did not have the influenza but whose children had had influenza in a mild form. She was in a badly run down condition and made a slow convalescence.

In the one case that developed in the hospital, culture showed staphylococcus aureus. Cultures were not obtained from the other patients.

The treatment which we have used for the nipple is practically the same as that outlined by Dr. Baer.

I have been impressed with the number of patients in the last year and a half who have developed tender areas in the breast; where it has been necessary to keep the breasts supported and to use ice caps several times while in the hospital and again after leaving the hospital. With prompt treatment these tender areas usually disappear in a day or two. Whether there is any direct relation between influenza and the increase in the frequency of breast abscesses is doubtful. But inasmuch as it does lower resistance it may be a predisposing cause.

Dr. Arthur H. Curtis: May I ask how long after evidence of abscess do you wait before you allow the baby to go back to the breast?

Dr. Baer: We wait the normal time, about 24 hours or more.

Dr. David S. Hillis: We have three important items in our armamentarium in treating cases with cracked nipples: first, the glass nipple shield; second, the lead nipple shield, and third, the tea strainer. The most important thing to be accomplished is rest for the nipple. This is secured by the glass nipple shield, and in the more severe cases we should remove the baby from the breast entirely. I still adhere to an old method of treatment which is serviceable in some cases which are not so severe, that is, in tender nipples which are not cracked. Here I use a lead nipple shield, and if within 2 or 3 days the condition does not clear up, more energetic measures are necessary. In the very bad cases, with cracked nipples and erosion, absolute rest and the air treatment, which is accomplished with the aid of a tea strainer under the binder over the nipple.

With regard to abscess of the breast, I have a rather strong prejudice in favor of the use of ice, and I believe I have had enough experience in abscess of the breast to say that ice properly applied early enough and long enough is the most efficient means of preventing abscess formation in these cases. I think perhaps the reason that ice is not more generally used is because of the method of using it. I believe that ice should be applied next to the skin, and the nurses in practically all of our hospitals are taught to apply a dry towel or dry piece of gauze between the ice bag and skin, on account of a fear of frost bite. As to the question of frost bites from an ice bag, I have been looking for them for 10 years but have not found one. A frost bite might

occur with an ice bag next to the skin over the shin bone, but not in a part with a blood supply such as is found in the nursing breast. It seems to me the danger is not a real one. One of my head nurses came to me in great anxiety one day and stated she wanted to show me a frost bite where an ice bag had been applied next to the skin. I went into the ward and the frost bite which she had observed in the morning had disappeared entirely. I believe that practically every threatened abscess of the breast can be avoided if properly treated with ice.

DR. MARK T. GOLDSTINE: I am very much interested in this paper on the etiology of breast abscess, but I am not fully convinced that cases of breast abscess are due to lowered resistance on account of the influenza epidemic.

I have had more cases of breast abscess in the last 2 years than ever before, and I have been trying to search for the reason, and rather than attribute them to the influenza epidemic, I have more or less attributed them to the infection we have had among the babies, which was so-called impetigo contagiosa. The rash and blebs these babies showed contained staphylococci. I am inclined to think the increase in the number of breast abscesses is due more to contact infection from the babies than to lowered resistance from influenza infection, for the reason I have had a great many more breast abscesses since we have had that epidemic among the babies.

I have a woman now who has a small abscess in each breast. The abscess started in one of the mammary follicles in the form of a small furuncle, about an inch and a quarter from the nipple, the small abscess having developed beneath the subcutaneous tissue. I opened it and drained it and it healed quickly. These abscesses will heal more quickly and with greater ease than the usual abscess of the breast heals.

Another thing I have noticed among babies is that they have mastitis. For many years I have seen a great many babies whose breasts were engorged but never went on to abscess formation. I have had four babies with impetigo in whom the breasts became engorged, and formed abscesses which had to be incised and drained. I do not think you can attribute them exactly to the influenza epidemic or to lowered resistance.

With regard to the treatment, one must be careful in opening these small abscesses not to do too much. They should be incised and drained, without any manipulation of the abscess cavity. The introduction of the finger or forceps to find whether lobules or abscess cavities are present may cause damage beneath the subcutaneous tissue which is not affected.

DR. EUGENE CARY: I wish to take exception to two statements made by Dr. Baer. First, with regard to the question of engorged breasts. I think the engorgement of the breasts is more or less mechanical. In other words, there is a beginning process in the breast that has lain dormant for a varying length of time, so that on the third or fourth day following delivery, as a rule, there is a great rush of blood to that part. My belief is that the veins in that breast have drained the normal, natural supply of blood to the breast, and on the third or fourth day, through some cause, as yet obscure, there is a sudden, increased blood supply to the breast, and these veins are called upon to do twice the work, the result being an acute congestion. This acute congestion means that there is more fluid going in than coming out. For that reason, there is a collection of fluid which means a swelling of the tissues, and there is an added restriction of the outflow, and my belief is that if that outflow is further restricted by putting on a tight binder or applying something which will congest the tissues, the trouble will be magnified.

It has been my practice for the last 7 or 8 years to try to relieve the resistance of the tissues by increasing tissue relaxation and dilating the veins rather than constricting them. For that reason, I have a standing order with all my cases that when the breasts become engorged and painful, they are to be steamed, which usually relieves the condition. The only reason I use a breast binder is for its supportive action, having it snug at the bottom and drawn up over the shoulders so that it acts as a hammock rather than a pressure binder. If a pad is put on the outside of the breast, and brought up to the midline, this is further facilitated. If heat is applied the tissues are relaxed and circulation is aided.

Another thing we want to realize, is that no matter where it is applied heat causes relaxation. A breast, when first used, will be hard, tense and painful, and the mere application of heat in the form of hot fomentations for 20 minutes, such as bath towels rung out of water, will give a great deal of relief from the pain. This is a procedure of routine with me and it works out satisfactorily; usually one steaming establishes increased circulation in the veins. It is a matter of half an hour or an hour. If the baby nurses after this the result is accomplished.

If the steaming does not relieve the congestion after nursing the next time, I usually make it a practice to steam the breasts thoroughly after having supported them in the proper position, and then apply pressure by the hands in a rotary manner, trying to express the venous engorgement, and massaging toward the axilla. The breast can be softened in this way and if gentle manipulation is practiced no damage is done to the tissues. The breast will be markedly smaller after the completion of the massage, and at the same time there may be practically no milk expressed from the nipple. Therefore, it seems to me the condition is not a congestion, enlargement, or caking due to retention of milk, but is simply a venous stasis.

When I was an interne, Dr. Lynch, now of San Francisco, told me that when he was at the Johns Hopkins they had treated five thousand cases expectantly, where the mother had either lost a

baby or had it removed from the breast for some cause. They simply let the breasts alone. I felt that was logical treatment, and I have been doing that ever since. I do nothing to the breast except put some hammock arrangement on without any compression so that it is comfortable. We have usually waited until the third day, and then I usually restrict liquids and give a saline cathartic, doing nothing to the breast. The next day the breasts are practically flaccid. There is a congestion period of about 6 hours, after which the breasts become flaccid and give no more trouble. A breast pump is never used.

If there is engorgement of the breasts and it is desired to continue lactation, why do you give cathartics?

DR. CARL WAGNER: I would like to ask Dr. Baer how he drains abscesses of the breast. I wish to mention a method in regard to the surgical aspect of abscess of the breast which has given me great satisfaction in the last 2 years in dealing with sinuses, as well as with carbuncles and suppurating areas in sinuses. I omit the use of all watery solutions of antiseptics, not even washing out the wound with such solutions. I use alcohol only on the outside of the wound. The sinuses I wash only with boric acid solution in the proportion of six drams to four ounces, which may be dropped into the sinus or put on cotton covered with nonabsorbable cotton, once or twice a day. The wound takes on a beautiful state of granulation, no matter in what part of the body I use this treatment. I do not wash out wounds any more; I do not put in a rubber drain except for a day or two. I like to get the abscess cavity enlarged on the outside, but the skin portion I treat a little longer than a day or two to permit me to drop in the boric acid and glycerin solution.

DR. N. SPROAT HEANEY: Ordinarily I believe that we are liable to attribute our avoidance of breast abscesses to the efficacy of our prophylaxis and the occasional breast abscesses which occur to a breach in technique. When streptococcus is the infecting organism in breast infections, it usually is introduced. This is the unusual type of infection however. The usual breast abscess is due to staphylococcus, which is a normal inhabitant of the surface of the nipples, the layers of the skin and the ducts of the breast, and it is the trauma of nursing or a deformed duct which stirs the staphylococcus into action. When trauma occurs the organisms produce an inflammatory reaction with a resulting periductal inflammation so that the duct itself becomes occluded and milk does not escape from the corresponding section of the breast. In stasis the organisms in the duct multiply and so an abscess or inflammatory reaction occurs. Whether an abscess results or not, I am not so sure that we can attribute to the aborting action of any therapeutic measure that we use.

Whether a baby should nurse a breast which is inflamed or not is a question which I think is open to discussion. I have heard of only one case where a baby was harmed by nursing an infected breast. Metastatic abscesses developed and the baby died. Where only a segment of the breast is affected, and that segment is drained and the breast is otherwise functionating, I have seen no harm from the baby nursing. The chances of the baby being infected under these conditions is small, as shown by the examination of milk pumped from both an infected and an uninfected breast and cultured. This has been done in several of our cases and only occasionally does the diseased side show many more organisms than does the unaffected side. Staphylococci I think are present in every mother's milk. They are harmless until trauma through bruising or cracks disturb the breast function, when they may attack the tissue itself.

DR. LESTER E. FRANKENTHAL: If we review the literature of the world, we must come to the conclusion that the influenza bacillus *per se* is of an innocent kind; that likewise patients who have had influenza are very susceptible to secondary infections. These secondary infections are usually caused by the staphylococcus, streptococcus, and pneumococcus. We see streptococcus anginas producing appendicitis, producing ovarian abscesses. We see in the wonderful paper written by Madelung on typhoid epidemics multiple abscesses in the breasts of patients. He quotes one instance, published in the *British Medical Journal* of 1902, of an abscess occurring in the breast 7 months after the onset of typhoid.

I therefore see no reason why one should doubt the direct relationship between our recent influenza epidemic and the increase in breast abscesses during that time.

If we have another epidemic, we shall attempt to control the occurrence of breast abscesses at the Michael Reese Hospital Maternity by obtaining the phagocytic and opsonic index of patients who have had influenza or have been exposed to the disease, and then governed by the index, we shall give them the mixed treatment of vaccines.

The last epidemic of influenza taught us the great possibility of abscess formation in spite of all care we could use.

I heartily endorse everything Dr. Hillis has said, and if I remember correctly, when he was an interne in the Michael Reese Hospital, we used the ice treatment.

When a woman has a rise in temperature, preceded frequently by a rigor, or chill, a sore spot in the breast with or without a visible superficial lymphangitis, we at once put the breast at rest, first however massaging the circumference of the breast in order to reduce all passive congestion, and subsequently applying compression with bandages, which previous to being covered by ice bags, are moistened so that the cold will readily penetrate to the skin. We have in mind two cases of extensive frost bites of the skin where the ice bag was directly applied to the same. If this treatment is instituted

early enough, we feel safe in saying that in 97 per cent of all cases of lymphangitis of the breast abscess formation can be prevented.

We make it a rule in the Michael Reese Maternity to have the head-nurse see every breast every day. It is for her to determine whether treatment is necessary or not. In this way we lose no time in instituting treatment at once.

I would like very much to stimulate some of the members of the society in the event of our having another influenza epidemic this winter, to try the prophylactic vaccine treatment in patients who either have had the influenza or who have been with influenza patients before their confinement.

DR. BAER (closing): In answer to the comments of Dr. Hillis concerning the use of the ice bag, we have contended with that problem in the Michael Reese Maternity with nurses who have been taught throughout the institution to apply the ice dry, and we have re-educated them to apply it wet, because that is the best way in which to get the chilling effect of the ice. It will not chill well when applied dry.

Dr. Goldstine referred to impetigo contagiosa as the etiological factor in the increased number of cases of breast abscess. To my way of thinking it is a less likely cause than that which I have advanced this evening. Impetigo contagiosa spreads rapidly when it does occur as an epidemic in the nursery. Several babies get it. They are isolated, and within a number of days or a week or two the epidemic is usually brought under control; whereas here are cases that have occurred over a number of months, and I prefer to adhere to the underlying cause which had been acting for two years, namely, influenzal infections.

I want to correct one impression Dr. Cary had concerning the treatment which we employ at the Michael Reese Clinic for congestion of the breast. I will read from my paper. . . . "We do not tightly bind the congested breast. We give the breast more room. We do not use tight compression except when we suppress breast function."

Answering Dr. Wagner, rubber tubing has been used in the past, but that has been discarded. After incision and gauze packing, changed daily until healthy granulations appear, we use a compression sponge with tight binder to hold the compression sponge in place. That seems to shorten the period of healing one-half.

Dr. Heaney said he continues to nurse a threatening breast. We believe that a threatening breast, like an inflammatory reaction anywhere else in the body, is best treated by physiological rest. Physiological rest for the breast does not include nursing. We prefer not to nurse a threatened breast, but to stop nursing. We believe that an attempt to rest one breast by not nursing and continue nursing in the other breast is an utter failure.

PERINEORRHAPHY FOR COMPLETE LACERATION

DR. THOMAS J. WATKINS read a paper entitled "Perineorrhaphy for a Complete Laceration." (See p. 360.)

DISCUSSION

DR. ALBERT GOLDSPOHN: In closing the rectal part of a complete laceration of the perineum the device of turning down a flap on the back of which the suturing is done, is very valuable, because the sutures can thereby be kept out of the rectal mucosa, where they otherwise become infected. But I regret to be obliged to criticise the doctor's technique in placing the sutures which are intended to reunite the torn sphincter ani and to close the rectal portion of the laceration. He represents that a leading suture in this attempt seizes the end of the torn sphincter and then is supposed to engage the *levator ani* muscle also, by something of a purse-string action. This attempt indicates a mistaken conception of the anatomy. The sphincter and levator are too far apart to make such a plan possible or feasible. The sphincter ani is among the outermost, almost subcutaneous, structures, of the perineum, while the levator ani is the extremely innermost structure in it. Down upon the normal level of the anterior rectal wall where this union should be made these structures are normally about 5 centimeters apart; and they are separated, among other tissues, by an unyielding septum composed of two layers of fascia with the deep transversus perinei muscle between them. This threeply non-elastic structure is called the *triangular ligament* in English anatomies, the *trigone* in some others.

It is the one relatively unyielding structure that a finger in the introitus meets normally, in a lateral movement, in cases where no laceration has occurred. I think the doctor, like many other operators, mistakes this intermediate fascial structure for the elevator ani. To bring the torn anterior portions of the levator ani and its fasciæ into effective apposition for real union, would require elevating a flap or extending the denudation and the suturing farther inward than is indicated by the essayist.

DR. WATKINS (closing): I am still convinced that I have some knowledge of the levator ani muscle notwithstanding what Dr. Goldspohn has said. I have repeatedly exposed this muscle and made direct suture when trying out the perineorrhaphy advocated by Malcolm L. Harris some years ago. I welcome this opportunity to make some general comments upon perineorrhaphies. The subject has become difficult chiefly on account of the confusion which has been injected into the literature. Aside from the literature, lacerations of the perineum are a relatively simple problem, both as to the nature and repair of the lesion.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

THIS work[1] by Dr. Heuser represents the latest and most thorough-going effort by a Spanish author to assemble the facts and principles relating to the practice of medical radiology. The work is well printed; the paper is satisfactory for the reproduction of roentgenograms; and the binding is substantial.

The first portion of the book is devoted to the technique of roentgenography with profusely illustrated descriptions of positions. Some new positions are described by the author, among them a new position for fractures of the occiput and a position for transrectal roentgenography of the coccyx and sacro-iliac joint. The author's acquaintance with apparatus is apparently confined to that of German origin. Since writing the book, he has visited the United States and has had opportunity to acquaint himself with the various types of American instruments. Due space is given the Coolidge tube.

As a matter of protection for the operator, the author advises that he stand always at a distance of at least 5 meters from the tube during roentgenography, protected by at least 4 millimeters of lead; and for roentgenoscopy, leather apron, protective shield, lead gloves, etc., and a maximum limit of 4 milliamperes in the tube. He very properly characterizes the lead glass tube holder as an "illusory protection."

That the work is unusually well up to date is attested by the detailed descriptions of methods of injection of air into the peritoneum, ventricles of the brain, etc. The author recommends for peritoneal injection a mixture of laughing gas, oxygen, and ether in place of oxygen, hitherto employed. As would be expected, appropriate space is devoted to the consideration of echinococcus disease of the lung and liver.

The latter portion of the book is devoted to the application of the X-ray in military surgery, and includes a detailed description of a number of localization methods including one which the author has named after himself.

This book is by far the best textbook on general roentgenography published in Spanish, and those who read Spanish will profit by its perusal.

JAMES T. CASE.

[1] TRATADO PRÁCTICO DE RADIOLOGÍA. By Dr. Charles Heuser. Buenos Aires: La Semana mèdica, 1920.

A MEDICAL book achieves a place upon our bookshelves in one of three categories; because of its value as a reference book, as a textbook, or because it represents an exhaustive, interesting, and well written mastery of a particular subject. Each field holds a distinct reward. A reference book is rarely a successful textbook, and a book to be used in teaching students cannot be a complete work of reference.

The subject matter covered in the book[2] under review does not lend itself to treatment other than that accorded to a book of reference. As such it appeals to us. Its value to an undergraduate student of medicine, we believe, is nil compared to its worth to the clinical neurologist. However, to be of value as a reference work, a book must have of necessity a complete, easily used index. Therein lies its worthiness. The bulk of this volume defies detailed criticism. However, testing it as a reference book, reveals a number of points of interest.

The aim of the authors to attempt to correlate anatomical and physiological neurology with the clinical aspect of the subject is a worthy one and is to be highly commended. Perhaps a happier arrangement of the subject matter, avoiding repetitions, would have allowed of a more detailed description of other points which are more desirable. A complete consideration of the cranial nerves is a case in point. Again, Ingvar's monumental work on the cerebellum should certainly have a place in a work of this character, as should the most recent work on the cerebral association tracts. The writers do not give credit in their subject matter to various authors, but have compiled a list of collateral reading references. Without doubt, this idea is valuable but in many instances failure to give credit is very obvious.

No doubt all of these points of omission are compensated for by the admirable translation the authors have given us of Déjerine's description of the internal capsule. The value of a good description in English of this structure has long been felt and this volume supplies that want fully.

As a whole, this stout compilation of many years of clinical experience and teaching is worthy to occupy a place upon the shelves of the most exacting member of the profession. L. E. DAVIS.

[2] THE FORM AND FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM. By F. Tilney, M.D., Ph.D., and H. A. Riley, A.M., M.D. New York: Paul Hoeber, 1920.

AMERICAN COLLEGE OF SURGEONS

STATE CLINICAL MEETINGS

Meetings of state sections of the Clinical Congress of the American College of Surgeons were held during February for the state of Arkansas at Little Rock, February 18 and 19; for Oklahoma at Oklahoma City, February 21 and 22; for Iowa at Des Moines, February 28 and March 1. At each meeting there were clinical, scientific, and public sessions and a hospital conference on standardization. The programs follow.

ARKANSAS

FRIDAY, FEBRUARY 18

Clinics

At the Baptist and City Hospitals and St. Vincent's Infirmary, 9 a.m. to 12 m.

Hospital Conference, 2:30 p.m.

William V. Laws, M.D., Chairman, Arkansas State Section, Presiding.

The Hospital Program of the American College of Surgeons and the Meaning of the Minimum Standard—Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

The Program of the American College of Surgeons as Applied to Catholic Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.

Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—James I. Scarborough, M.D., Little Rock.

Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—A. B. Tipping, Superintendent, Touro Infirmary, New Orleans.

Discussion—Opened by Anderson Watkins, M.D., Little Rock.

Public Meeting, 8 p.m.

Hugh Hart, Chairman.

Address of Welcome—Thomas C. McRae, Governor of Arkansas.

The American College of Surgeons—Harold M. Stephens.

The Relationship of the Surgeon to the General Public—William R. Cubbins, M.D., Chicago.

How the Public Can Assist in Reducing the Mortality of Cancer—C. Jeff Miller, M.D., New Orleans.

The Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President, Catholic Hospital Association.

SATURDAY, FEBRUARY 19

Clinics

At the Baptist and City Hospitals, and St. Vincent's Infirmary, 9 a.m. to 12 m.

Scientific Session, 2:30 p.m.

William V. Laws, M.D., Chairman.

Fracture of the Lower End of the Ulna—St. Cloud Cooper, M.D., Fort Smith.

War Orthopedics Applied to Civil Life—John S. Jenkins, M.D., Pine Bluff.

Frontal Sinus Operations—H. R. T. Mann, M.D., Texarkana.

The Treatment of Carcinoma of the Uterus by Surgery and Radium—C. Jeff Miller, M.D., New Orleans.

The Present Status of the Operative Treatment of Fractures—William R. Cubbins, M.D., Chicago.

OKLAHOMA

MONDAY, FEBRUARY 21

Clinics

At St. Anthony and Wesley Hospitals, 9 a.m. to 1 p m

Hospital Conference, 2:30 p.m.

Horace Reed, M.D., Oklahoma City, Chairman, Oklahoma State Section, Presiding.

The Hospital Program of the American College of Surgeons and the Meaning of the Minimum Standard—Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

The Program of the American College of Surgeons as Applied to Catholic Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.

Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—Horace Reed, M.D., Oklahoma City.

Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—P. H. Fesler, Superintendent, State University Hospital.

Discussion—Opened by LeRoy Long, M.D., Oklahoma City.

TUESDAY, FEBRUARY 22

Clinics

At the University and Baptist Hospitals, 9 a.m. to 1 p.m.

Scientific Session, 2:30 p.m.

Address of Welcome—LeRoy Long, M.D., Oklahoma City.

Proper Operation for Carcimona of the Breast—Jabez N. Jackson, M.D., Kansas City.

The Treatment of Carcinoma of the Uterus by Surgery and Radium—C. Jeff Miller, M.D., New Orleans.
Paper—Fred S. Clinton, M.D., Tulsa.
Discussion of cases presented at the morning clinics—McLain Rogers, M.D., Clinton, Okla.; F. L. Carson, M.D., Shawnee, Okla.; S. L. Murdock, M.D., Sabetha, Kans.; R. V. Smith, M.D., Tulsa, Okla; A. W. Roth, M.D., Tulsa, Okla.; and D. D. Esterley, M.D., Topeka, Kans.

Public Meeting, 7:30 p.m.

Horace Reed, M.D., Chairman, Oklahoma State Section, Presiding.
Address of Welcome—Dr. Stratton D. Brooks, President, Oklahoma State University.
The American College of Surgeons—Harold M. Stephens.
The Menace of Cancer—Jabez N. Jackson, M.D., Kansas City.
How the Public Can Assist in Reducing the Mortality of Cancer—C. Jeff Miller, M.D., New Orleans.
Standardization of Hospitals—Rev. C. B. Moulinier, S.J., Milwaukee.
Why the Church Believes in Medical Education of the Laity—Rev. I. Frank Roach and Rev. E. D. Salkeld, Oklahoma City.

IOWA

MONDAY, FEBRUARY 28

Clinics

At the Iowa Methodist and Iowa Lutheran Hospitals, 9 a.m. to 12 m.

Hospital Conference, 2:30 p.m.

The Hospital Program of the American College of Surgeons—Harold M. Stephens, Director, Hospital Activities, American College of Surgeons.
The Soul of Standardization—Rev. C. B. Moulinier, S.J., President, Catholic Hospital Association.
The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—Rev. F. O. Hanson, Superintendent, Iowa Lutheran Hospital.
Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—Donald Macrae, M.D., President, Iowa State Medical Society.

Public Meeting 8 p.m.

W. W. Pearson, M.D., Chairman.
Address of Welcome—N. E. Kendall, Governor of Iowa.
The American College of Surgeons—Harold M. Stephens.
The Menace of Cancer—J. N. Jackson, M.D., Kansas City.
Public Health and Community Responsibility—John B. Deaver, M.D., Philadelphia.
The Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President, Catholic Hospital Association.

TUESDAY, MARCH 1

Clinics

At the Iowa Methodist and the Iowa Lutheran Hospitals, 9 a.m. to 12 m.

Scientific Session, 2:30 p.m.

W. W. Pearson, M.D., Chairman.
Jaundice—John B. Deaver, M.D., Philadelphia.
Proper Operation for Cancer of the Breast—J. N. Jackson, M.D., Kansas City.
Factors of Safety in Surgery—Major G. Seelig, M.D., St. Louis.

MEETINGS TO BE HELD

Ohio—Cleveland, April 1 and 2.
New Jersey—Newark, April 11 and 12.
Virginia—Richmond, April 14 and 15.
West Virginia—Wheeling, April 18 and 19.
Michigan—Detroit, April 28 and 29.